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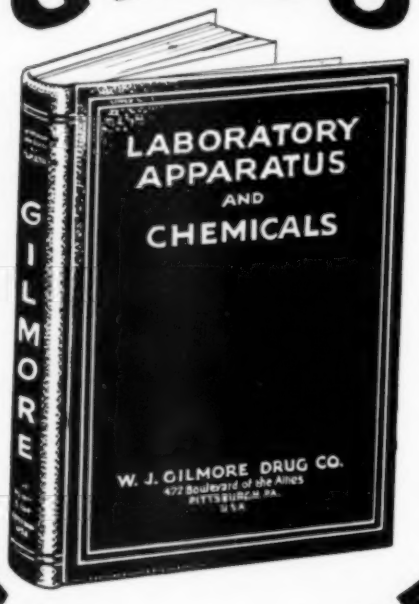

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The Science Counselor

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National Science Essay Contest . . .

Early announcement of the 1941 Duquesne University National Science Essay Contest is made so that Catholic high schools everywhere will have an opportunity to give increased thought and preparation to their entries. Each year competition for the first honor grows keener as more and more schools throughout the United States enter the contest, and as the essays submitted continue to improve in quality.

All Catholic high schools which teach any of the sciences are invited to participate by submitting *one* student essay on the assigned topic. In order that the greatest good may result from this competition, it is suggested that the essays entered in the national contest should be selected by means of contests in the individual schools.

Teachers are not to expect individual invitations for their schools. *This is an official invitation to all Catholic high schools to enter this contest.* It is an invitation to *your* school.

The essays submitted in this competition will be judged by members of the faculty of Duquesne University. Form, content, and expression will be considered. A gold medal, for permanent possession, will be awarded to the writer of the best essay. Several honorable mentions will be made, the number depending upon the excellence of the essays submitted. A suitably engraved silver cup will be given to the winning school. The cup will be held for one year. It will then be passed on to the school receiving the new award. This cup is now in the possession of the St. Rosalia High School, Pittsburgh, the school which won the 1940 contest.

Announcement of the winner will be made at the next annual Conference for teachers of science which will be held at Duquesne University in February, 1941. The prize essay will be published in full in the SCIENCE COUNSELOR. Only winning essays and schools will be announced. A list of the schools which enter the contest will not be published.

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For Good or Ill?

● **By Arthur H. Compton, Ph. D.,** *(Princeton University)*
PROFESSOR OF PHYSICS, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

Not long ago I attended the dedication of a great new telescope, built with supreme skill to capture light from the farthest stars. Here was a marvelous instrument to widen the horizons of men and enable them to learn more about their place in the universe. Yet, at the very moment of dedication, the same optical and mechanical skill which created the telescope was being used also to build precision range finders for controlling with deadly accuracy the firing of great guns.

In recent years physicists have been experimenting with the momentous possibility of releasing the energy locked in the atoms—energy which, we now know, feeds the sun's hot fires and is vastly greater than that available in any fuel on earth. As yet nobody is certain whether this source of energy really can be tapped, but the chances now look definitely favorable in the not distant future. Indeed, within the last year we have come so close to releasing this atomic power that we are already worrying about the uses to which it might be put.

One of America's internationally known workers in science, winner of the Nobel prize for physics in 1927 as well as other high honors, here discusses science and religion.

His views, indicative of a trend, will be especially interesting to Catholic teachers of science.

Dr. Compton, and the American Magazine in which this article appeared in April, 1939, graciously permit the SCIENCE COUNSELOR *to publish it.*

Imagine releasing, from a pinhead of uranium, energy equal to that in a ton of coal! Such a gift, in the controlling hands of men of vision and humanity, might well mean the beginning of the end of poverty, a new world of comfort, industry, and security such as we have hardly dreamed. But, in the hands of tyrants, it might destroy or enslave us all.

So it is that science can be used as readily to our harm as to our good. With human good will and co-operation, scientific knowledge can lift us all toward world progress and peace. But with hatred and greed, and the rivalry of antagonistic groups, it can become terribly destructive.

Thus science today is creating a situation in which strife endangers everyone, and co-operation gives rich rewards for all of us.

Thus there is need as never before of love of our neighbors. There is need of universal acceptance of this central doctrine of Christianity.

Just as the automobile demands sobriety, and congested city life requires careful sanitation, so the mutual dependence of a technological civilization implies consideration of the rights of others.

Clearly, what we need is the development of new social attitudes. Here is a cause greater than ourselves, an objective worthy of our supreme effort. Here is the great appeal of the holy war, the spirit of the missionary who would share with others his good news, the patriot who prays for liberty or for death. Only as we lose ourselves in such a task do we truly live.

Religion and science are thus allies in making possible an enriched and stable society. Science can supply the means of enriching life, and even the raw materials for building our world of ideas, but only religion is able to show us the vision of the world that we would build, or give us the inspiration to devote our lives to building that world.

Science has shown us the gradual growth of life through hundreds of millions of years, under forces which have at last brought into being men who see that with their powers for good or ill they have a responsibility for shaping their world, that they are indeed their brothers' keepers. Before men recognized that responsibility, the Creator held life entirely in His hands. Now man shares the great task of making the world what he would have it. He becomes a child of God, working with Him toward a common goal.

As a people to whom has been given a double share of the power of science and the freedom to select our own objectives, let us in America not fail to catch the vision of the greater world that we would create. Truly it is to us that the world must look for leadership. Holding the vision of that greater world, let us have faith in our God-given power of science and use that power in the service of man. ●

The Recently Restored Historic Church of St. Peter, Brownsville, Pennsylvania, Reverend M. F. Brennan, Pastor

A New Horizon

● **By A. W. Curtis, Jr.**
ASSISTANT, RESEARCH AND EXPERIMENT STATION, TUSKEGEE INSTITUTE, ALABAMA

Here is a brief story of the work of Dr. George W. Carver, the "first and greatest chemurgist," written by one of his Assistants at the Tuskegee Institute, Alabama.

No other scientist has surpassed this patient worker in the number of products obtained from a single agricultural product, in this case the peanut. But Dr. Carver's researches have not been confined to one field. Soil fertility, the creation of wanted products from waste materials, and the development of new uses for farm products have interested him. Directly and indirectly hundreds of thousands of persons have benefited by the work and teachings of this noted scientist.

Recently he has given his life savings as a nucleus for the establishing of the George Washington Carver Foundation for the promotion of agricultural and chemical research as applied to the native plants and resources of the South. Contributions to the Foundation are now being received.

●

To establish a home in this country seventy-five years ago it was first necessary to clear the land of trees to provide space for the home and garden. The soil was virgin and considered impossible to wear out, but through the years as land was cleared unrestrictedly of its protective coating of forest, cropped continuously with soil depleting crops, exposed year in and year out to the ravaging effects of wind and rain,—impoverishment for land and people was inevitable.

At one time farming was for the purpose of supplying the family with food and other necessities that could be produced directly and indirectly from the soil. With the improvement of transportation and the development of farm machinery, greater markets were open to the farmer, enabling individuals to till large acreages. At the same time, however, little or no attention was being given to the maintenance of soil fertility, or to systematic control of production. Farmers generally were producing food for several times the number they had been formerly supplying. This resulted in oversupplied markets. Technical advancements were being made in machinery and in production methods, but no attention was given to the development of ways of utilizing the additional farm produce being grown.

This Nation is now farm-for-industry conscious, seeking means to advance, sponsor, and encourage research into Nature's mysteries. The plants, which are Nature's laboratories, utilize elements present in the atmosphere and in the soil with the aid of solar energy in the presence of a catalyst, chlorophyl, to manufacture sugar and starch and convert these compounds into the more complex compounds that are essential in the life cycle of a plant. From the simple elements that are necessary in plant growth, compounds are formed that are being used extensively for industrial purposes. The cellulose, carbohydrates, lignin, oils, gums, and rosins of plants have been found through chemical research to be adapted to many of the requirements of industry in supplying the consumer with products that possess necessary qualities and features.

Dr. George W. Carver, of Tuskegee Institute in Alabama, has been a pioneer in the utilization of agricultural waste, finding new uses for agricultural crops, and developing products of industrial value from farm crops. He was the first Director of Agriculture at Tuskegee Institute, and when he came to the institution in 1896, he gave to agriculture a new outlook, to industry a new alliance, and to chemistry a new meaning. The crop-worn and badly eroded soil of the region was depicted in the living conditions and appearance of the people. Improper farming practices and dwindled markets, based upon a cotton economy from which it was impossible to eke out an existence, made the problem an acute one. Cotton had always been the principal crop of the Southern region, the only one that most of the farmers were familiar with and for which there was a market at a price. Those who ventured into growing other farm produce for marketing were disillusioned because of the lack of a market for anything other than cotton, thus reverting them back to their old practice of growing cotton to the doorstep and sacrificing all garden space in order that some probable cash money would be available, and at the same time making necessary the purchase of food that could have been grown around the home.

The problems that Dr. Carver faced upon his arrival at Tuskegee Institute were of great magnitude, requiring a broad approach and a balanced concept of the problems involved. He advocated the diversification of crops, soil conservation, live-at-home, utilization of waste and natural resources, and the development of new uses for farm crops, as partial solutions of the farm problems of this region. He advocated the growing of peanuts and sweet potatoes as the two crops to be used to retire a portion of the cotton acreage. He lectured to the farmers, prepared exhibits for the Tuskegee Fair and Farmer's Short Courses, and demonstrated on the Experiment Station plots the practicability of the suggestions and advice he was disseminating.

He illustrated in a tangible way the merits of his soil building program by taking over three acres of land that was classified as useless for farming purposes and restoring it in three years to a productive level by the use of winter cover crops, muck from the swamps, and compost prepared from decayable campus refuse. The first year there was a deficit of ten dollars an acre, but

at the end of three years he was realizing a profit of seventeen dollars per acre.

To encourage farmers to live at home, a number of vegetables were grown on the experimental plots, harvested, and then preserved to show to the farmers the variety and quality of vegetables that could be grown on their soil. To be certain that this phase of his program would also be successful, it was necessary for him to show the housewife how to prepare for human consumption some of these vegetables that they had never seen or heard of before. This has been one of the principles upon which the success of his work has been based: to be equal to the occasion and to complete the problem in its entirety, thinking only of the task to be accomplished.

Dr. Carver experimented with soybeans, peanuts, sweet potatoes, clovers, corn, and numerous other crops, but he advocated the growing of peanuts and sweet potatoes to replace a part of the cotton acreage because they were already being grown to a limited extent, and therefore would not be crops that the farmer did not know how to cultivate. Encouraging farmers to grow crops they were not acquainted with would have meant, if not defeat for his program, a serious handicap to the progress being made.

He was aware of the fact that to encourage farmers to increase the production of peanuts and sweet potatoes, and at the same time not to expand the markets for them, would be a breach of the primary principles of economics, and the catapulting of a catastrophe onto the farmers that would be as serious, if not more serious, than the one of which they were already victims. What was the solution to this phase of the problem? New and expanded uses for peanuts and sweet potatoes, uses for these crops not for human consumption alone but industrial uses as well.

A laboratory was not available. The school was not in a financial position to provide a laboratory, but that was not a serious obstacle. With beakers made by cutting the tops off bottles, and by collecting mortars, evaporating dishes and other essentials from discarded material, this "first and greatest chemurgist" launched a research program that is recognized today as a partial solution to unemployment, as a means of restoring economic stability to the farm population, of preserving the Nation's exhaustible resources, and of providing the consumer with products possessing properties of strength, durability and lightness equal, and perhaps superior, to products supplied from the inorganic world.

From the peanut, three hundred products have been developed. A milk, when augmented with deficient elements, was equal in nutritional value to cow's milk. This was a necessary and welcome addition to the diet of rural people where cow's milk was not available. By the use of this vegetable milk the probable transmission of communicable diseases from cows that had not been tested for disease was eliminated. The peanut, being highly nutritional (a pound of peanut butter contains 17% carbohydrates, and one and one-half times as much protein, over three times as much fat, and three times as much fuel value as a pound of round steak), was highly recommended for use in improving the diet of southern rural families. A few of the other products from the peanut are: condiments, cosmetics, hair oil, oil, plastics, protein, paper, stains, insulating boards, ink and glue. One product of the Carver Laboratory which is still in the experimental stages of development and which has attracted nation-wide attention, is a peanut oil for use in the treatment of atrophied muscles. The experimental findings with this oil thus far are most encouraging and promising.

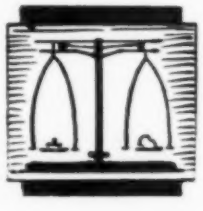
By quantitative and qualitative analysis of the peanut and sweet potato, and a knowledge of the three main products of agricultural crops, carbohydrates, fats, and proteins, Dr. Carver has by chemical operation upon them produced his hundreds of products.

The sweet potato products number 118, and a few of the products included in that number are: vinegar, breakfast food, ink, stains, glue and paper. The industrial possibilities of the peanut and sweet potato have not been explored in their entirety. The research work with these crops that is being carried on at the present is accomplished with difficulty because of insufficient financial assistance.

Dr. Carver's research has by no means been limited to peanuts and sweet potatoes, but has included a majority of the plants indigenous to the South, waste material, and the natural resources. A number of other products Dr. Carver has produced are: paper from twenty different native plants; fuel; briquettes; artificial marble; benches from sawdust; face powders, paints, stains, calcimines and vases from clay; and several hundred vegetable dyes.

To extoll Dr. Carver as just a scientist and humanitarian is not to encompass the range of his great gifts because he is also an artist. One of his paintings won second prize at the Chicago World's Fair of 1893. On July 24, 1939, his last painting, begun more than twenty years ago, was completed and unveiled on that date. The painting titled "Two Southern Aristocrats" is a composition of the Yucca and Cactus in flower.

Dr. Carver in his effort to serve at all times the man greatest in need of help has made his life a symbol of all that is good, and a great inspiration to the youth of America. And to this end he has given his savings of a lifetime ($33,000.00) to the establishing of the George Washington Carver Foundation to perpetuate and further creative research in the development of new uses for farm crops. ●



Fluorescence as Project Material in High School Science

● **By C. K. Chrestensen**
DEPARTMENT OF CHEMISTRY, PUBLIC HIGH SCHOOL, CLAIRTON, PA.

Here is an up-to-the-minute, inexpensive science project that will keep your classes interested for months. Even the non-science departments of your school will want to participate. Its possibilities are almost inexhaustible.

Mr. Chrestensen is doing an unusually fine piece of work in stimulating students to study science by creating so much interest in the projects he selects that pupils forget that the sciences are supposed to be "hard" subjects.

The work suggested in this paper will interest the teacher as much as it does the pupil.

Better try it!

●

It is becoming a problem for the chemistry and physics teacher to maintain interest in the teaching of senior high school science. If one compares the present day textbook with that of a decade ago, it is apparent that the task has become more difficult because of the addition of many new laws, theories and industrial processes. The presentation of this vast amount of material to students tends to make science, as a high school subject, too theoretical and too advanced for average pupil assimilation. The subject is labeled "hard" by those taking the course, and, as a consequence, other pupils will not take it; if they do enroll, the work is uninviting to them.

Another important factor that changes the perspective in the science teaching of today is the type of student enrolled. A score of years ago high school pupils were rather a select group, most of whom were academically inclined. At present the average falls below this standard. Many do not have the ability to master difficult science material. When we take into consideration the fact that while there are fewer students studying physical science these are herded into large groups, due to the increased cost of education, it is apparent that there is need for clear vision in our approach to the problems of science teaching.

The writer wishes to make it clear that an attempt is not being made in this article to determine what should be taught, but rather to set forth some means of making the sciences more palatable to the high school student. What can the teacher do that will aid the pupil studying chemistry and physics to derive greater benefit and find greater enjoyment in the study of these subjects? This is a question that seems to be in the minds of many science teachers. In the past three years the writer has received many letters from high school science teachers requesting experiments and stunts that could be used for more effective teaching. Frequently the requests take the following form: "I am in accord with your ideas of having more science demonstrations. Can you send us some interesting experiments?" or "What do you have in the way of interesting experiments that will make our teaching more effective?" or "We want to have a science club. What can you suggest?"

In twelve years of science teaching the writer has done considerable research based on the idea that the teacher should create greater interest in science. The aim has been to present the work in such an interesting manner that the student will have a desire to surmount the technical hurdles. One of the projects worked out in this research involves the study of fluorescence in ultra-

Fluorescent materials photographed in ordinary light.

Photographed in ultraviolet or "black" light only.

violet light. While it is impossible in this short article to point out all of the possibilities of the project, enough will be given to enable teachers not only to use this material, but also to help them in developing their own ideas.

Many teachers will understand clearly the meaning of the term "fluorescence," but for those who may not be familiar with the word, we state that it means a secondary light ray given off by certain materials when irradiated by short wave light. In the development of this project two things must be considered: first, sources of short wave light; and second, chemicals that will be affected by this light.

The sources of ultraviolet light—"black light"—are varied. One may use a carbon-arc with a black glass filter to remove the visible light. The black glass bulbs or tubes now marketed by the electric light companies prove very convenient. For classroom work an 85 watt bulb is sufficient. Still another suitable source is the ordinary health lamp. The light from this lamp, like the carbon-arc, must be screened with a black glass filter to remove the visible light.

The second requirement for the development of the project is the study of fluorescent materials. This part of the program is clearly a duty to be assigned to the chemistry students. The classes may take the line of least resistance and purchase their fluorescent materials, but since in our project we wish to create interest in science it is better that the students make their own paints. If funds are limited, this is by far the most economical method.

There are many substances that will fluoresce to a limited extent, but not in sufficient amount to be used for demonstration purposes. The student should use, therefore, only those chemicals that will produce a strong fluorescence. These materials may be divided into two classes: water solutions containing the dissolved fluorescent chemicals, and lacquer base paints.

Fluorescent Liquids

An excellent red liquid may be prepared by dissolving a small amount of rhodamine B. in water. This may be used to dye cloth. It gives a strong fluorescence with a suitable short wave light source.

An orange colored liquid may be obtained by dissolving a small amount of eosine in water.

A strong yellow-green fluorescent liquid may be prepared by dissolving fluorescein dye in water.

Primiline will give a good blue-green fluorescent liquid when the dye is dissolved in water. The liquid itself is not very fluorescent, but when cloth is dipped in the solution the material gives a beautiful blue-green color in black light.

Esculin produces a liquid which gives a splendid blue fluorescence. The liquid itself is colorless in ordinary light. In ultraviolet light, however, the solution is blue, and cloth treated with it is very striking in appearance.

In preparing these liquids only a very small quantity of dye is necessary. One twenty-fifth of a gram is usually sufficient to prepare one liter of solution. It is better to use a small quantity of the dye, adding more if necessary. When too much is used the solution as well as the treated cloth will be too dark and will not give a bright fluorescence. Small pieces of cloth (white cotton or rayon) may be dipped in the solution and tried under the lamp. In this way one will soon learn to obtain the desired shade. It should be clear that all tests must be carried out in a dark room as ordinary light destroys the effect of the black light on the fluorescent material.

Fluorescent Paints

Fluorescent paints are quite easily prepared and provide an excellent project for the science student. A light colored lacquer, slightly thinned with alcohol, provides a good fluorescent paint base. The chemistry student will find it an interesting diversion to prepare the paint, repeatedly trying samples under the black light rays to obtain the desired shade.

A good red fluorescent paint may be prepared by dissolving about one-eighth of a gram of rhodamine B. in 3cc. of ethyl alcohol and mixing the dissolved dye into four ounces of lacquer. If this does not produce enough color, a little more dye may be used. The dye should be entirely dissolved before it is stirred into the lacquer.

An orange paint may be made by dissolving a small amount of rhodamine 6G in alcohol and mixing it with a larger amount of eosine. A few trials under the lamp will give the desired shade.

A yellow colored paint may be obtained by dissolving equal amounts of eosine and fluorescein dye in alcohol and mixing the two colors into a few ounces of lacquer. In the three colors mentioned above, lighter or darker shades may be obtained by varying the amounts used.

A bright blue may be obtained by mixing finely powdered sodium salicylate into lacquer. The chemical will not dissolve and is therefore in suspension. This paint must be stirred before using.

A strong fluorescent green paint may be prepared by stirring finely powdered anthracene into a thin solution of cellulose acetate dissolved in acetone. This paint will also be in suspension and must be stirred before using. A different shade of green may be prepared by dissolving a small amount of primiline in alcohol and mixing the dissolved dye into lacquer.

The science teacher will find it easy to devise means of using the fluorescent paints and liquids. Several high school departments may take part in this venture, with the result that science may be brought to the attention of a larger number of students in the school.

The light sensitive liquids may be used to make cloth fluorescent. After immersing the goods in the dye solution the material should be allowed to dry. In incandescent light the treated cloth will present a drab appearance that is changed entirely in the black light. A solution of fluorescein sprayed on white cloth will produce a beautiful effect under the cold light rays. An ordinary fly sprayer will serve for this purpose.

The spray method provides an excellent way of making invisible signs. Letters may be cut out of heavy paper and attached with thumb tacks to a piece of porous wall board. The entire board should then be sprayed with a solution of anthracene in benzol or carbon disulfide. After the letters are removed the board

Continued on Page Eighty-eight

The Chemistry Teachers Club of New York

● **By Ernest B. Wilson**
PRESIDENT, 1938-1939, THE CHEMISTRY TEACHERS CLUB.

Successful teachers of chemistry are always seeking new experiments for laboratory and lecture table use, as well as for improved methods and different procedures. Such teachers will be interested to learn of some of the work that this progressive metropolitan club has been doing to improve the teaching of chemistry, especially the technique of demonstration.

One of its former Presidents gives a factual account of some of the demonstrations that have been given recently before the Club.

There are tricks to all trades. Here are some new ones for the teacher of chemistry.

●

Although many prominent speakers have made inspirational addresses on various aspects of methodology and philosophy of teaching in its meetings, this Club has directed its efforts towards improving the technical knowledge of chemical industry among its members, improving the type of demonstrations and experiments presented in the classroom laboratory, and to improving the demonstration technique of its members. The experimental investigation of classroom problems of chemical education has been left to other clubs or societies functioning in the metropolitan area. The majority of the chemistry teachers of this area are members of several clubs which work in specific fields. Because of this fact the Chemistry Teachers Club has been restricted, traditionally at least, to the objectives mentioned above.

The yearly program in which various members of the Club present demonstrations and experiments has stimulated the interest of the members in this type of school activity. It has promoted improvement in demonstration technique and encouraged the use of a wider variety of experiments and demonstrations.

Many of the demonstrations presented are not immediately applicable to classroom teaching but are more suitable for pupil club projects and for special occasions such as chapel programs or department meetings. Enterprising teachers frequently adapt such material to classroom use, however.

For example, a member recently demonstrated how aluminum can be melted and burned by means of a large Bunsen burner. The aluminum is heated to a high temperature which causes a film of oxide to form. Further heating melts the metal underneath. If the heating is continued and the film broken, some of the aluminum will take fire and burn. Both sodium and lithium have been obtained from their fused chlorides by electrolysis. The inside of small vacuum bulbs has been coated with sodium by electrolysis. A twenty-five watt electric light bulb is connected in a circuit for electrolysis so that the filament is one pole and lowered into a beaker of fused salt which has the other pole in it. Under these conditions electrons travel from the filament and form sodium atoms from the sodium ions in the glass. The prevention of explosions of mixtures of hydrogen and air by means of a roll of copper gauze inserted in the delivery tube has been demonstrated. Sulfur dioxide, ammonia, and nitrogen have been catalytically oxidized. Water gas was prepared from the reduction of steam by means of a carbon arc. Electrolytic oxidation and reduction and various electro-plating experiments have been among the numerous special demonstrations presented.

No doubt every teacher is aware of the importance of presenting demonstrations so that the manipulations, the chemical changes that occur, and the results obtained will be clearly visible to every member of his class. This technique has received special attention in the meetings of the Club. Some applications are discussed in the following paragraphs.

Advertisers use inclined mirrors to show objects not directly visible to a person looking at an exhibit. A teacher used this idea to show his pupils the gradual developing of picture films in a trough. This technique may be used in other situations where more visibility is desirable. It has been used to show growth of crystals, and the magnetic field as outlined by iron filings.

Another teacher used devices similar to show windows. He constructs apparatus such as pneumatic troughs, electrolysis cells, conductivity cells, etc., with glass sides so that pupils can follow the reactions without difficulty. The commercial laboratory supply houses furnish such devices made of glass, but they are usually small and somewhat expensive.

Reactions with litmus paper can be made more effective by the use of strips of paper two inches wide and twelve inches long. Such paper must be used in beakers or in test tubes of at least one hundred millimeters. Usually litmus solutions prove more effective than the paper because the reaction can be made more clearly visible by the use of large volumes of solution. The litmus solution is quickly made. It keeps the laboratory cleaner also.

A college lecturer showed how he made his demonstrations of indicator changes and color reactions much more visible by using ten liter flasks instead of test tubes. He claims that very little additional material other than water is necessary. His demonstrations are

Continued on Page Eighty-five

An Extracurricular Natural History Program

● **By Richard Lee Weaver, Ph. D.,** *(Cornell University)*
COLLEGE NATURALIST, DARTMOUTH COLLEGE, HANOVER, N. H.

Dartmouth College is now conducting a successful experiment in extracurricular education that is designed, in part, to stimulate the interest of both the College and the community in natural history and woodcraft.

In this paper the College Naturalist who directs the program outlines the objectives that have been set up and discusses the activities that have been engaged in and the results that have been achieved. Wide awake teachers will observe that parts of the program can well be adapted for high school use.

If other educational institutions follow Dartmouth's lead, every town or community will some day be able to find a trained Naturalist when it needs him.

●

When Thoreau wrote, "Every town or community will have its naturalist just as it has its doctors and lawyers," he was probably impressed with the necessity for administering to peoples' natural interest in the out-of-doors and the need for directed leisure so that they might have less occasion to need the ministrations of the latter professions.

DR. RICHARD LEE WEAVER *was graduated from Pennsylvania State College with a Bachelor of Science Degree in Nature Education, and from Cornell University with the degree of Doctor of Philosophy majoring in the field of Natural History with minors in Ornithology and Mammalogy. He taught three years in the Maumee Valley Country Day School in Toledo, Ohio, where he conducted a natural history program in all of the grades from I to XII.*

It has taken a great many years for this philosophy expressed by Thoreau to receive enough attention in any community to make it a reality rather than an objective for the future. However, progressive leaders at Dartmouth College have recently made Thoreau's prediction come true in one instance. They have launched an expanding program of extracurricular education designed to cultivate and stimulate interest in the fields of natural history, woodcraft, and art. In 1938, a College Naturalist and an Artist in Residence were appointed to the staff to initiate work in these fields.

College Naturalist—A New Portfolio

President Ernest Martin Hopkins, and Dean of the Faculty E. Gordon Bill, in 1937, called together a group of the faculty representing all of the divisions of the College interested in or engaged in natural history and recreational activities. As a result of this initial meeting, enough interest was expressed in the development of an extracurricular natural history program that a smaller committee of five was appointed to prepare a tentative program, suggest a suitable location for the work, and recommend available candidates for the position to be created. The committee consisted of Dr. Winslow Hatch as chairman, representing the Dartmouth Outing Club and the Botany Department; Dr. Leland Griggs, representing the Zoology Department; Professor W. W. Bowen, representing the College Museum; Dr. Frederic P. Lord, representing the College community as a whole; and Professor Thomas Dent, representing the Recreation Department.

After a year's work, the committee proposed a suggestive outline of activities that could be correlated with the College program generally, made suggestions as to the location of the work in the College, and the type of person needed for the position of Naturalist.

The writer was completing a Doctorate at Cornell University in the fields of Natural History, Ornithology, and Mammalogy. The committee made its recommendation for the position and the appointment was made in May, 1938, giving the writer the title of College Naturalist, with the rank of Instructor on the regular faculty.

Location of the Work in the College

Among the objectives established by the committee concerning the work were to keep it as free as possible from the regular departmental divisions of the College, and to have the Naturalist relieved of all formal teaching duties. The reason for this was to make all students feel free to participate in the work, and to permit the Naturalist to be free to get out into the field at any time with any group or individual. It would also facilitate the planning of the program so that it would be as

effective as possible and not be dominated by any one department or organization on the campus.

These objectives were achieved by establishing the work as a separate entity, housed in a special building, and by having the Naturalist be responsible directly to the Dean of the Faculty. The simplicity with which the program is organized has aided greatly in the success of the work in the initial two years. The various divisions of the College have worked out effective means of cooperation.

Office of the Naturalist

The special building devoted to the work is equipped with an office, a darkroom, laboratory, display hall, and workshop. The building can accommodate audiences as large as fifty people. It is centrally located at one corner of the main campus quadrangle next to the College Museum.

The office and library of the building house a working library of books and pamphlets as well as many current periodicals on hunting, fishing, conservation, natural history, and wildlife management. Many of the students using the building for a workshop, reading room, or for working on special projects in photography and taxidermy are privileged to have keys to the building.

How Contacts Are Made

By a diversified program of lectures, day and week-end field trips, research projects, and regular accounts and announcements in the local papers, and through personal contacts with the students, faculty, and townspeople, the Naturalist's presence in the community has become evident to many of the people of Dartmouth, the town of Hanover, and to some extent in the state.

Several of the faculty members have arranged to have the Naturalist talk to their classes in zoology and nature literature, and in this way students have become aware of the offerings of the extracurricular program of natural history. In the courses in elementary zoology and in natural history the students are advised of the possibility of doing cooperative field projects and some of the students have availed themselves of this opportunity.

In the Recreation Department through the encouragement of the Director, Professor Robert J. Delahanty, the men wishing to use natural history activities as a substitution for indoor gym and regular sports, are referred to the Naturalist. If the boys are interested enough in the field to conduct small outdoor projects such as bird banding, systematic observation, small mammal trapping, or any other allied work, they are permitted to do this and receive recreation credit for the work.

Regular announcement of the field trips, lectures, and special activities conducted are included in the weekly College Calendar and printed daily in the College paper. The weekly accounts of observations on natural history, containing descriptive material and records of bird migrations and the time of flowering and fruiting of plants are published in the weekly town paper.

Displays of books on birds and other natural history subjects have been prepared for use in the College Library during the season of greatest interest. Help is also given in the collection of materials for current displays of local wild flowers in the Town Library throughout the spring and summer. These exhibits have run continuously for over twenty years. The preparation of a list of birds as they arrive and depart, which was conducted by the Town Library in the past, has been turned over to the Naturalist.

Members of the Dartmouth Outing Club formed a Natural History Club as a division of the Outing Club and selected the Naturalist for their advisor. The Club holds its meetings in the office of the Naturalist and uses the laboratory facilities for its projects. The program of lectures, activity meetings, field trips, and week-end excursions, conducted by the Club, is available to all students interested. Monthly and yearly reports of the activities of the Club, including many valuable nature records are published and distributed. Such things as checklists of birds and flowers for the region have also been made available to the public by the Club members.

A non-credit course for preparing camp nature counselors was conducted during the second semester of 1939-40. Thirty men learned the techniques involved in running a nature program in a camp or a hotel. Such activities as nature trails, museums, games, field trips, campfires, photography, and record keeping were included in the course. Some of the men were available and were recommended for positions in camps this year, while others returned to their positions as nature counselors obtained in years previous. This course will no doubt become an annual one so that Dartmouth can do its share in the training of men for these important

A group of students studying botany in the field to supplement their regular courses in botany.

Two members of the Natural History Club working with Dr. Weaver in the utilization of study specimens prepared during the hunting season in a cooperative project between the Club and local hunters.

positions. The College is strategically located for participation in this work and is well qualified to expand its sphere of influence in this field.

Informal discussions on birds and other nature topics are conducted at the local elementary and high schools. Here the children have an opportunity of meeting the Naturalist and many of them have responded to the invitation to participate in the field trips which are regularly conducted for them during April and May. Talks are also given to the Boy and Girl Scout groups of town and help is given on their preparation for nature awards. For these talks, portable cases of mounted birds have been developed in cooperation with the College Museum.

Talks to local Rotary, Civic, Nature, Fish and Game, and Garden Clubs, as well as to many of these groups throughout the state, give the Naturalist an opportunity to make many contacts. Some of the people in these local organizations participate in the regular field trip and lecture program. By working with such groups as the New Hampshire Academy of Science, the State Department of Education, the State Teachers Colleges, and the Biological Institute of the University of New Hampshire, the Naturalist is able to contribute some help to the state programs of nature and conservation education.

Other Activities of the Naturalist

Fulfilling another objective of the planning committee, the work was arranged so that no formal classes would be taught where credit was given and examinations required. This has permitted the Naturalist to be free at any time to work with students or groups and makes the work entirely dependent upon interest. In such cases as this, there is a direct correlation between the amount of enthusiasm and energy shown by the leader and the amount of response by those affected by the program.

In order to provide projects which would extend over a period of time and permit the coming and going of those interested at various times, such things as natural history surveys of the region have been undertaken. These include birds, mammals, flowers, trees, and amphibia. Bird banding, bat banding, small mammal trapping, wildlife censusing, wildlife photography, and systematic museum collecting were some of the initial activities. As rapidly as material accumulates it will be used in suitable publications covering the region studied. Some notes and articles on birds and mammals of the area have already been published and others are in the process of preparation.

All specimens collected as a part of the surveys are turned over to the College Museum and Herbarium for use by classes and others interested. Students assist in the preparation and the care of these materials.

Colored slides of wildlife subjects, wild flowers, and trees of the region are being prepared and will be available for teaching and lecturing purposes.

Weekly and seasonal bird censuses are taken by students and members of the community. These records are compiled locally and sent to the New England Museum of Natural History and to the United States Biological Survey for inclusion in their published lists of birds seen in New England. First and last records for each species are kept. An attempt is also made to calculate abundance by ordinary censusing techniques. In the spring and fall, records are made of the flowering and fruiting dates of local flowers and trees. Spring and fall bird censuses are also taken each year by members of the Natural History Club.

Bird records for New Hampshire and Vermont are being collected in view of the preparation of an account of the bird life of these areas.

Plant distribution and identification are being studied by a group of interested faculty members and townspeople. Fern and flower keys are tried to study their effectiveness, local plants are collected, and lists are prepared for amateur use in the community. More ex-

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Office of the College Naturalist. It contains an office, library, laboratory, darkroom, and workshop, and is used for many of the activities in the natural history program conducted by the Naturalist, and also as a headquarters for the College Natural History Club.

The Junior Academy of Science

Outstanding Problems and Their Possible Solutions

● **By Anna A. Schnieb**

PROFESSOR OF EDUCATION AND PSYCHOLOGY, EASTERN KENTUCKY STATE TEACHERS COLLEGE, RICHMOND, KENTUCKY.

This paper, read by Professor Schnieb at the Columbus meeting of the A.A.A.S., is a valuable contribution. It represents much work on the part of the writer who has added to the value of her study by offering certain definite and sensible conclusions based on specific findings.

The Junior Academy plan is an excellent one. It should succeed. To be wholly successful, however, increased interest and attention must come from those in a position to act.

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This study has been a genuine pleasure:

First, because of the honor of being invited to speak to this very important and distinguished organization.

Second, because of the unquestionable importance of the Junior Academy of Science and the apparent need of furthering its activities.

Third, because of needed assistance in solving the problems which I have encountered, and the belief that solutions might be reached more effectively by a cooperative study of difficulties encountered by other state councilors and by club sponsors and club presidents.

Problem and Procedure

The problem in this study was to see in what way the work of the Junior Academy of Science can be made more effective; what are the outstanding difficulties and how they may be solved.

First, the question was reconsidered: Does the science club have a place in the high school? Does it really meet the needs and the interests of the adolescent? If it only means, as the president of a state university answered when asked to lend his support in organizing a Junior Academy, "Just another club to which dues must be paid, another distraction from the regular school work, and a psuedo-adult activity," it certainly has little if any place.

In the 25th *Yearbook* of the National Society for the Study of Education, L. V. Koos lists 848 so-called extra-curricular activities. According to Edmund Conklin, "Such activities provide the means for satisfying the urges of youth. They offer opportunity for display, for activity, for thrill, for leadership, for the consciousness of power, and for the observation of approval of one's own acts and achievements."(1)

F. M. Thrasher states: "The duration of adolescence is generally marked by conflicts consequent to the attemps of the growing personality to adjust itself in its larger social milieu which represents a new world for the emerging adolescent. If these new needs for expression are not provided for by the conventional agencies, they will be met in other ways by the adolescent."(2)

We will agree, I think, to the answer of our first question that:

1. The science club, as no other club, offers an outlet for the needs and the interests of the adolescent. According to psychologists the adolescent wants adventure and new experiences; he wants to see things happen. The adolescent is meditative and reflective; he wants to find out things for himself. To be convinced of this, one needs only to hear the exclamations of high school pupils over some personal discovery. The speaker, when working with a group of eighth grade pupils, once was hurriedly summoned to come to the indoor beehive. When the pupils were asked what they saw, one boy quickly replied, "O boy, O boy! Bees have hip pockets. Don't you see them? Who would have dreamed it?" At the moment bees were returning to the hive with their pollen sacks filled. This observation led to detailed study of the bee. Materials were ordered from Washington and from a supply house.

2. The science club plays an important role not only in the school, but also in the community in that it is one of the few clubs that can function throughout the year, including the vacation. Many science club members make excellent collections of science materials to be studied when school opens. The individual member can work alone as well as with the group. One State Junior Academy offers a ten dollar award for the best collection or observation made during the vacation. Life situations are those which John recognizes as having meaning and significance to him. This meaning and significance spring in part from the out-of-school life of John, but also to a large degree from the cumulative vicarious experience. School experience becomes real and vital in proportion as the teaching makes it so.

3. The science club is second to none in making provision for individual differences which is made possible by the large number of varied fields in science. This is evident in the Kentucky exhibit which has been assembled by the science club of Bellevue, Kentucky, and on display here.(3)

The trite statement is often made, "The future of America lies in its youth." That sounds well, but in what way does it prompt us to action? Samuel Everett of the Lincoln School makes clear that the high schools must be reconstructed. "In the past," he says, "the courage and intelligence of youth was challenged by unexplored frontiers, the discovery and use of huge natural resources, the building of a great industrial nation, and the expansion of economic and cultural relations abroad. Youth must be encouraged to see a new vision and to work toward its fulfillment. The greatest opportunity of American Secondary Schools is to study

the present and the future possibilities inherent in American life, to explore the new frontiers which must now be conquered. It should do its part in arousing in young people of today the experimental and dynamic drive which in the past has characterized generation after generation of American youth."[4] The science club offers such a means.

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After this rededication to science clubs, a careful study was made of the needs of the work of the Junior Academy as experienced by the state councilor of the Kentucky Junior Academy of Science and as indicated from time to time by the club sponsors and the presidents.

The addresses of the state councilors were obtained from the National Coordinator, Dr. Howard E. Enders, Purdue University.

A letter was written to Dr. F. R. Moulton, Permanent Secretary, A.A.A.S., requesting the addresses of the state councilors of Junior Academies, in order to avoid any possible omissions.

Data were obtained from three groups of science workers. Twenty-eight letters were written to the state councilors, including three to state secretaries of Senior Academies because of incorrect addresses, and seventy-one to the club sponsors and the presidents of the Kentucky Junior Academy of Science, including one sponsor of an out-of-state club. The letters were a personal inquiry concerning the difficulties encountered in the science club work and possible ways of meeting them. Postage was enclosed. Excellent cooperation was received which is indicated by the following percentage of replies: 86% state councilors; 72% club sponsors; 26% club presidents.

The rather small percentage of club presidents replying perhaps its due to the fact that many of the presidents of last year are not now in college.

A careful analysis was made of each reply in the three groups and the problems were tabulated with their respective solutions.

Findings

A surprising unanimity in the replies of the three groups concerning the outstanding problems was noted.

There are today thirteen State Junior Academies and three City Academies.

There is no official office where the Junior Academies are registered, thus making it very difficult to obtain authentic information.

The outstanding problems evolved from this study are:

1. *The need of a science consciousness which when acquired will solve the problems so often listed:*

"Not enough time"
"Too many other clubs"
"Frequent change in sponsors"
"Lack of sympathetic administrators"
"Need of wide-awake, enthusiastic sponsors"
"Need of financial assistance."

A consciousness for science, which is one panacea for many of the so-called difficulties, will be acquired when the college courses for the science teachers are fraught with realities; when the experiments in the college laboratories as well as in the high school laboratories are closely related to the science needs and interests of the community.

Liebnitz, one of the great pioneers in research, said: "Whenever I find a new truth, I immediately ask, "What does it mean to life?" President Conradi maintains: "The student must be led to see that all the physical comforts and conveniences of modern civilization have been made possible by mathematics and science, the very subjects he studies in the classroom and in the laboratory. To give the proper emphasis to the practical aspect of these scientific discoveries does not belittle, nor degrade them. We must have some understanding as to what these sciences mean to the home, to agriculture, and to all the various phases of our industrial life in order that he may be able to chart his own life on a basis of intelligent and creative living."[5]

A science consciousness can further be developed by occasionally having the club members list their daily activities and by studying the science implications. Special science programs and science demonstrations given by the club members to which parents are invited the same as for other school programs will widen and deepen the interest. An exchange of science club meetings between schools the same as for glee clubs and dramatics will be effective.

A science consciousness can further be developed through genuine cooperation of the State Academies of Science with the club sponsors by supplying scientific literature, by frequently writing for the daily press scientific articles in the language of the laymen and by the various members visiting the affiliated clubs. The State Departments of Education can do much by taking a definite stand for the field of science by assisting in assembling scientific loan exhibits for high schools.

2. *The problem of financial assistance,* which was frequently given. However, in the judgment of the speaker, this is secondary. This may be solved by lessening the expense in the awards by substituting ribbons. Another solution is for the individual clubs to devise means of raising special contributions. For example, sponsoring a science motion picture, a science fair, a science play, etc. This from the speaker's observation has had far-reaching value in stimulating club and community interest. School Boards when convinced of the value of science activities will be interested in giving financial assistance, which is illustrated by the Bellevue School Board. The State Academies and the A.A.A.S. can make their tie-up with the Junior Academy much more effective by giving financial assistance. This can be done if just a portion of the annual allowance of the A.A.A.S. to the State Academies be given to the Juniors. Perhaps if the State Academies would spend just a little less for publishing their proceedings, a larger contribution could be made to the Junior Academy. The State and County Medical and Dental Associations will assist when convinced of the effec-

tiveness of the work, as also will people of means who are public spirited citizens.

3. *The problem of affiliation with State Academies and the A.A.A.S.* The lack of affiliation is keenly felt as also is the honor of affiliation as is shown in the following quotations from just a few of the replies received:

"My Certificate of Membership is framed and hangs in the most prominent place in my room. The Certificate has brought great joy and happiness to me and still does. When I received it, all the local newspapers had an article about it and I received numerous congratulations and letters, which of course, naturally made me feel happy and proud. To high school students, the Certificate would be more attractive if it had some added color and for framing purposes it should not be folded.

"As you requested, enclosed please find my Certificate of Membership. In this Certificate my name is misspelled and the seal is not affixed. I wrote the secretary about the misspelling of my name and the omission of the seal and he sent me another Certificate with the seal affixed and my name spelled correctly, which as stated before, is framed and hanging in my room.

"Yes, we all feel a part of the Kentucky Junior Academy of Science, because we are working on a display that is to be in competition with displays from all over the state, and if for no other reason, this makes us feel definitely a part of the Kentucky Junior Academy of Science."(6)

"No, I don't think we ever felt as if we were a part of either the Kentucky Academy of Science or the A.A.A.S. because we never attended any of their conventions and never was in close touch with either organization, while in the Kentucky Junior Academy of Science we meet and make friends of our own age and understanding."(7)

"We do not belong to the A.A.A.S. We feel that membership in A.A.A.S. would be a great benefit. We would however feel better about such membership if it carried on some financial support for the local affiliated membership rather than merely having on paper that we are members. In other words I feel the science club needs concrete and specific help to meet its needs. It needs more than just suggestions and loads of talk of what it should and could do. We all know what we want and most of us know how we are going to do it."(8)

"At the present time we feel very much let down by the A.A.A.S. The reason is that at our last annual convention Alice Kinnaird an outstanding pupil was made an Honorary Member of A.A.A.S., yet neither she nor I have ever received any recognition from that organization. Her certificate of membership and her subscription to Science News Letter have never arrived. The entire club feels that in some way we are being slighted and are at loss to understand. We were very proud of the honor. We had been very proud of the fact that we were affiliated with *such a great organization.* Perhaps we misunderstood."(9)

A similar reply was received from the club sponsor for the other honorary member stressing the disappointment of both the honoree and the school.

"My club and I certainly feel that we are a part of the Kentucky Junior Academy of Science for several reasons:

a. Today our members are enjoying the National Geographic as an award presented to us by the Junior Academy of Science for having the largest percentage of club membership present at the annual meeting.

b. One girl who entered the discussion contest is now wearing a club pin presented to her by the Junior Academy of Science.

c. At the opening of this term our club received a check for five dollars for having the best exhibit at the annual meeting.

d. We know what is going on from time to time in the Junior Academy through the Junior Science Bulletin. We are sure that it is the very finest publication which our school receives. It is truly a scientific student publication which is being recognized by great scientists.

e. The fact that our delegates control in a democratic way the procedure and policies of the Junior Academy of Science makes us feel that we are really a part of the fine Junior Academy.

We are sorry to say that we do not feel closely connected with either the senior organization in our own state or the A.A.A.S. because:

We have no medium or publication from either, consequently, we know practically nothing of their work.

We do not hear reports from their meetings except through our Councilor."(10)

It is obvious that affiliation is deeply appreciated, but that it has not been clearly defined. Perhaps we councilors have expected too much as is indicated by a letter from the Permanent Secretary which reads:

"Apparently you have read a little more into the relationship of the Junior Academies with the Association than we intended. The purpose of electing honorary junior members was to give the State Academies an additional connection with their affiliated Junior Academies and science groups. At the same time we thought it would be on the whole advisable to acquaint the Juniors with the existence of the A.A.A.S."(11)

The speaker hopes that during this meeting definite affiliation may be arranged.

4. *The problem of distance between high schools and the annual meeting place.* A feasible solution is to hold district meetings at which time the best discussions and exhibits may be selected for the annual meeting. This would greatly stimulate local interest in that many more could participate. It would also do much toward refining the programs for the annual meeting. A two day meeting could be more easily arranged as the attendance would be lessened. A Junior publication for and by the club members containing illustrations and published regularly will do much to hold the interest and to unify the affiliated clubs of the state.

5. *The problem of securing trained sponsors.* This can be solved by Teachers Colleges and Schools of Education giving courses in club work in which opportun-

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Making High School Science More Productive. Part II.

This paper, and the two that follow, formed a part of a Panel Discussion on "Making High School Science More Productive" that was presented before the 1940 Duquesne University Conference for Teachers of Science in Catholic High Schools. Very Reverend Raymond V. Kirk, C.S.Sp., Ph.D., President of Duquesne University, acted as Coordinator.

Three other papers from the program were published in the June, 1940, number of the Science Counselor.

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Laboratory Work

By SISTER M. deLOURDES, S.S.J., A.B.
(Duquesne University), St. Joseph High School, Natrona, Pa.

Laboratory work, whether in physics, chemistry, or biology, can be made more productive by a concerted effort on the part of teachers to widen its scope; to enable the student to discover for himself fundamental principles that are often dry and uninteresting when imparted in lecture periods; to inculcate a realization of the fact that experimenting is not confined to a room set apart in the school building, but that innumerable opportunities for scientific investigation exist everywhere.

Experimental problems should be interesting. They should be of such a nature that the student will recognize them as being worth-while; they should stimulate his curiosity, and encourage him to enlarge upon his directed study in school by individual projects elsewhere; they should provide him with information and skill that will prove useful throughout his lifetime in solving scientific problems as they arise.

In biology, the demand today is to make dominant the study of *living* things from a more or less experimental point of view. Too often, dissection occupies first place in the laboratory, and biology becomes the study of slides and of preserved specimens. The problems created in this laboratory adoption of living things center mainly around the question of what material to present and where to obtain it.

At the beginning of the school year, beetles, moths, butterflies, and a variety of other insects are available. Fruits and nuts abound and afford an additional interest when studied with special reference to species. Placing rows of apples even along the window sills, labeled "Baldwin", Northern Spy", "Maiden Blush", "Jonathan", "Delicious", etc., make the apple mean more than the ordinary piece of fruit. It also creates an easy approach to the study of borers, grubs, the codling moth, and other pests that infest leaf, stem, trunk, and roots of the tree. Goldenrod and asters are outstanding blooms of the season. These add beauty to the class room and can be utilized for examination of flowers, arrangement of leaves, and kinds of roots.

October offers countless opportunities for laying in supplies that can be used for laboratory work when the weather outdoors becomes more bleak. Leaves of all kinds, in gorgeous color, illustrate the withdrawal of chlorophyll; seedpods can be had for the taking—dogbane, cockle-burr, Spanish needles, canna, cucumber vines, and others. A seed collection is illimitable. Cocoons can be found everywhere, and tent-caterpillar eggs and bag-worm cases can be obtained, studied, and destroyed. Mold appears uninvited on the Jack-O-Lanterns cut from pumpkins for Hallowe'en, while insect larvae and various other types of parasitic life are plentiful in and on fruits and nuts of the season.

November ushers in the hunting season, and whenever one can have a hunter exhibit his collection of small game to a class, there is no lack of interest. Lichens on the trees are at their best, and protococcus can be found in abundance.

On into the winter we find galls, skunk cabbage, and mosses of all kinds. Willow twigs, elm, cottonwood, and horsechestnut buds can be brought into the laboratory and there observed as they develop.

With the approach of Spring, there can be found egg masses of the spotted salamander, noisy peepers, frogs, toads, all of which develop in the laboratory.

A balanced aquarium permits the study of living things throughout the year. A number of small fish, several shrimp, a variety of snails, can live in harmony. One or two small crayfish can be kept with this selection of living things until they become large enough to devour their companions. With them can be watched the growth of valisneria, sagittaria, cabomba, elodea, and lemna or duckweed. Spirogyra and edogonium make interesting additions.

A small type of balanced aquarium can be maintained with a variety of protozoa—paramecia, vorticella, stentor, rotifers—with growing algae such as oscillatoria, nostoc, and other species. Hydra will live in battery jars together with small crustaceans upon which they feed. A living clam will survive a reasonable length of time in any container deep enough for a three-inch layer of mud under the water.

One or two terraria afford space for growing mosses, liverworts, and a few lichens such as parmelia, usnea, and cladonia cristatella. Walking sticks' eggs or an ootheca of praying mantis' eggs can be placed on watch glasses under bell jars in a terrarium where grass and clover have been planted. The walking sticks, when hatched, will feed on the grass and clover; the praying mantis must be furnished with other food. Newts, salamanders, and turtles add interest to a terrarium where a container of water is embedded in the soil. Strong twigs held firmly in the soil of the terrarium provide an excellent means of hanging cocoons until the moths emerge.

With the advent of hydroponics or chemiculture, there is a new field of observation and experimentation in the botanical phase of biology and in the chemical make-up of plant life. In addition, biological supply houses are ever advancing new ways of studying life, and have perfected means of raising bees and of maintaining ant colonies in specially constructed devices.

Regarding chemistry: A good way to stimulate experimental tendencies in the potential chemist, and to encourage his frequenting the laboratory outside scheduled hours, is to give a demonstration by generating various gases, for example—oxygen, hydrogen, chlorine, hydrogen sulfide, hydrogen chloride—gases that are in common use. The respective number of generators should be set up beforehand, and the materials previously assembled. Another help is to familiarize students early in the school year with the three great classes of compounds—acids, bases, salts—showing them how to test for chlorides, sulfates, bromides, nitrates, etc., as well as for starches, sugars, proteins, and fats, thus giving them a definite tie-up between their everyday experiences and the laboratory. Solutions, suspensions, and colloids open up another field and lead the student into a search for electrolytes and non-electrolytes, and to an understanding therefrom of ionization and electrolysis, physical functions all important to an understanding of modern chemistry.

Distribution of litmus paper for students to use at home testing meats, milk, soap, butter, vinegar, fruit juices, etc., is a splendid incentive for enlarging the field of experimentation and observation. A brief instruction on coal may take the student to the coal bin to examine the glossy streaks and determine carbon content, amount and quality of ash.

Of utmost importance in laboratory work is the requirement of absolute honesty in reports on experiments and observations. A student should report what *did* happen, not what he has read should happen. Learning *why* what should have happened did not happen, is further experimentation.

A final brief word applicable to all sciences, but here stated with reference to physics: We must keep up to date. Radio, neon lights, "black light," television, sodium lights, stratosphere flights, are present scientific accomplishments that cannot be passed over in our study of physics. They should serve as an incentive to teacher and to pupil to be ever on the alert for new wonders that will in the future rise above our scientific horizon. ●

Choice of Subject Matter

By BROTHER FREDERICK C. HARTWICH, S. M. Licentiate, Science and Mathematics *(University of Fribourg,* Switzerland). Boys' Catholic High School, Pittsburgh, Pa.

General Criticism of Aims in Theory and Practice

There is one rather severe criticism which may be applied to the entire science program in the high school, with the exception of the course in general science. Most of the courses seem to lack human interest. The materials are organized about the interests of scientists rather than about the interests of high school boys and girls and of ordinary persons. Noll says:

> "Instruction as now given does not function in the thinking and doing of most persons. The habit of scientific thought has hardly touched the vast majority. We use the material comforts and provisions that science gives us daily, with never a thought about the method that made them possible. The purpose uppermost in the minds of teachers and pupils alike is to pass examinations, not to make science function in thinking and acting. Individuals in all walks of life invest in enterprises of which they know little or nothing; spend millions annually on worthless or positively harmful beauty aids and quack medicines; and consult fortune-tellers and dozen of other varieties of quacks. Science can accomplish no greater purpose than to eradicate the type of thinking that tolerates and even encourages such things."(1)

The offerings in a given science aim to give the individual a comprehensive view of the subject matter of that science rather than that insight and technique which will be of greatest value to him in meeting the problems of everyday life.

In planning a science course, we should consider first the mental development of the child, particularly with relation to his native interests and abilities; and second, the fact that the child has to be fitted into a social group as a cooperating member of society as well as an individual.

General Science

The subject matter of general science should be selected to a large extent from the environment. It will, therefore, vary greatly in different communities. Science is universal and constant in the life of our citizens; hence to be useful to all pupils, general science must accept the science of common things as its legitimate field. The science of common use and that of the classroom should be the same.

The particular units of study should be those that truly interest the pupils. Interest not only secures productive attention but is an evidence of attention. To be substantial educationally, interest must rest upon a sense of value, an evident worthwhileness in the topics considered. Pieper says:

> "The subject matter should deal with activities and problems interesting to the child and which form part of his experiences. Emphasis should be placed on practical adjustments to environment by means of activities that are, so far as possible, based on direct and concrete experiences.(2)

More than half the science materials found in our most widely-read periodicals and newspapers deal with biology; about one-fifth to one-fourth deal with physics; and not more than one-fourth deal with all other science. If what people read every day is a criterion of what they need to know about science, then the analyses of current reading materials speak a plain and pointed language.

Text-book analyses reveal that if general science is to be made meaningful and functional to adolescents, it must be put in terms that are within their vocabularies.

Also, it emphasizes the need for vocabulary drill in general science classes.

Analyses of the current reading matter of children indicate a strong predominance of biology, physics and astronomy, whereas the textbooks reveal generally more space devoted to physics (usually largely mechanics) and physical geography than to other branches of science.

A general science course should be organized about the following major fields:

1. Electricity, including the radio.
2. Astronomy, centered particularly about the earth, other planets, the stars.
3. Biology, including plants and animals.

The Selection of Content

The greatest need in the field of high school science teaching today is a reorganization of content to meet the needs and interests of present-day life. If we once inculcate this elementary but fundamental principle in our thinking about the curriculum, we shall have made a great step forward. It sometimes seems so much of an accomplishment to revise the course of study that this, once done, is happily forgotten for the next decade or two. It seems likely that the plan of organizing science content around major generalizations of science has the greatest possibilities of success.

Biology

Biology should, first of all, give the child an understanding of its living environment; secondly, it must give him a scientific understanding of his own human mechanism.

When selecting the basic materials for a course in biology, we should consider:

1. The interests of the students.
2. The particular type of his environment, so that desirable adjustments can be made to the kind of life which the pupil is called upon to lead.
3. The activities of the pupils in the home, school, community.
4. The difficulty of concepts to be taught; the socio-civic value of the course. Stress the mutual dependence of plants and animals, the common reaction of living things to stimuli, the fact that green plants make the food of the world, the interrelations of plants, animals and man, the relation of health and disease to microorganisms. The vital importance of man.

Biology texts have devoted too much space to mere fact finding and fact statement rather than to developing a problematical point of view and giving the student practice in making generalizations based on the big fundamental ideas and concepts.

Chemistry

As a branch of instruction, chemistry is in need of reorganization, and there is evidence that those who are most interested in it are aware of the fact.

The modern textbook is "thicker." The earlier books were generally abbreviations of the college texts and included about two hundred to three hundred pages. New data on the structure of matter, and increasing emphasis on industrial applications and commercial processes account for most of this growth. The back bone of the course remains much the same. Malin[3] analyzed text-books and sent a questionnaire on the content of courses in chemistry, which was returned by 96 teachers in 47 states. He found that many of the same things are taught everywhere and in nearly all schools, just as are valence, nomenclature, and writing of formulas and equations. Of course, it is entirely legitimate to ask what should be taught, if these are not. These should probably be included in a course for students who go on to advanced work in chemistry. Perhaps some idea of these matters is desirable even for those who take their first and last chemistry in high school. The important question is: What else should be taught in chemistry?

The average course in chemistry treats the following topics: (besides those mentioned above) disinfectants, germicides, fuels, cleaning agents, chemical preparations, solvents, chemical composition, paints, varnishes and waxes, explosives and inflammable material, acids, drying agents, preservatives, fermentations, bases, emulsions, and colloids.

A committee of the North Central Association submitted the following definite set of units rather than topics which emphasize the relation of chemistry to man and which have proven most helpful. The units are as follows:

1. Chemical changes in everyday life.
2. Elements, the simplest form of matter.
3. The ten elements necessary to life.
4. Some simple compounds of the essential elements.
5. How simple compounds combine to form others.
6. Some other useful and interesting elements.
7. The relation of chemistry to human health.
8. Uses of chemistry in the home.
9. Applications of chemistry in our daily life.
10. How chemistry is applied in industries.
11. How chemistry contributes to the welfare of society.
12. The chemistry of plant and animal life.
13. The relation of chemistry to the progress of civilization.
14. Generalizations and the solution of problems.

A text-book written along these lines would be a boon to progressive teachers of chemistry.[4]

Physics

Noll remarks: "Of all the sciences taught in secondary schools, physics has suffered the greatest decline in popularity. The figures on the proportions of the high school population enrolled in the different sciences show that physics has declined in the last half-century from a leading position to one near the bottom of the list."[5]

Physics somehow has failed to catch on in the present-day high-school curriculum because:

1. As usually taught it is dry and uninteresting to all except a small number of pupils who have special interests.
2. It is mathematical and difficult.
3. It is not practical in the sense that typewriting or auto mechanics or even biology is practical. The ability to perform household tasks, including repairing of appliances based upon scientific principles, was listed as a legitimate aim of science teaching. Although physics might accept this as a legitimate goal, its attainment would surely not constitute sufficient reason for teaching this subject, in secondary schools. A course in household mechanics would probably be much better for such a purpose.
4. We lack good teachers of physics. Not that we do not lack them in other subjects, too, but sometimes the teacher of physics in high school doesn't know too much about it himself. Only a small number of college students major in physics and, since it is a difficult subject, one who has had but a smattering of it in college is unfit to teach it satisfactorily.
5. It is slow in following the lead of the newer science textbook organizations.

Noll remarks that "Physics teachers are by no means agreed that what is in the text-books is what should be there, nor are they agreed on what should be taught in its place. Much of what is being taught in high school physics is of little value or interest to the average layman. That what we teach is not all useless is equally clear, but the time wasted on 'dead material' is large."(6)

Conclusion

It seems probable that eventually our courses in science up to and including the junior college level will be for the most part general courses. At the same time opportunity will be given for specialization for those who wish it and who are qualified to pursue specialized courses.

In the main, however, our science courses below the senior college division are tending to fix their objectives as preparation for life and especially for the life of the majority of people. This involves less emphasis on the technical and abstract phases of science and more on the kind of science needed in vocations, in leisure-time activities and for appreciation and enjoyment. ●

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Preparation of the Science Teacher

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In keeping with the advice which we find in Cicero's works, I think that it may be well to begin with a definition of the terms in the title of the topic we are about to discuss, namely, "science" and "teacher". Science we will consider under its general meaning of a classified knowledge of the facts concerning nature. As for the term "teacher", I think that the best definition is that found in the introduction of the New York State *Syllabus* in Education. There the teacher is summed up as one "in loco parentis"—one in place of the parent. Now we like to think of parents as being unselfish, kind, patient, honest, and greatly devoted to their children. Thus, a teacher, if she is to be successful, must possess these qualities so that she may instill them into her pupils to the pupils' advantage.

What is true of a teacher, in general, is especially true of a science teacher since she has the singular privilege, during laboratory periods, of meeting the student just as he is. At this time the student is more truly himself, not the veneered individual that we so often meet in more formal classes such as mathematics and Latin. Therefore, if the teacher's ability and tact for meeting others on their levels has not been developed, her teaching will be a failure so far as helpfulness to the student is concerned.

In an article relating to a recent report which concerned an investigation of the Regents Examinations in New York State, Dr. Gulick wonders if it would not be better for the secondary school student to be instructed by persons who have less specialized knowledge and more general information concerning their major field. Carrying this thought into the scientific field, it not infrequently happens that a teacher, let us say a specialist in zoology, finds herself assigned to a general biology class; here she will pour out torrents of zoology upon unsuspecting individuals who have not yet become sufficiently familiar with the fundamentals to peer through this screen of animal life to discern the man beyond. In the world of education such a teacher may be justly termed a "dictator." On the contrary, if the training has been more liberal, that is, if the teacher has taken courses in other subjects besides her major field, her teaching will be more practical and efficient. For example, if one has majored in zoology and finds herself teaching high school general biology, she will be greatly benefited by a fundamental knowledge of chemistry, physics, botany, bacteriology, and human physiology. In addition, history, philosophy and ethics form an essential background, to say nothing of several other courses that might be included for a general culture. A person trained in the way just mentioned will not only feel capable of teaching the subjects assigned but will be invaluable in helping her pupils to adjust themselves to their environment and to decide their place in the field of worldly activities as well as in directing them in her particular field. Such a teacher may well be defined as one "in loco parentis."

If it is true, and it is, that "the teacher as the public servant *par excellence,* exemplifies the social man," how much truer is it that the science teacher, properly trained and possessing a well developed personality, becomes a beacon light leading the adolescent mind away from the sordid things of life to an interest in the mar-

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Lead, a Basic Natural Resource
Part I - Production

● **By F. E. Wormser. E. M.,** *(Columbia University)*
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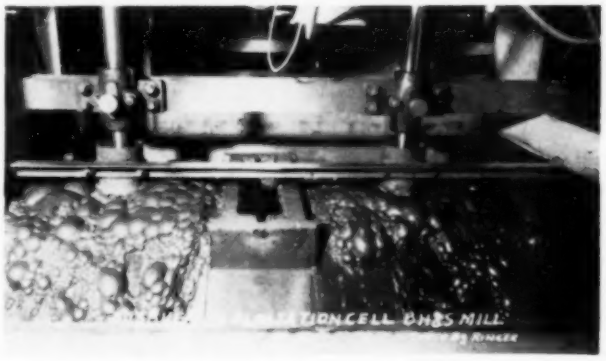
This is the first of two articles on the production and uses of Lead, one of our most important basic natural resources.

A second article, which will appear in an early number, will deal more specifically with the uses which the modern world makes of a metal that has been known from the earliest times.

The present article contains out-of-the-ordinary details and valuable information that are not usually immediately available to teachers of high school science. It should be filed for reference.



Froth from flotation cells, rich in lead content.

Lead is a metal with which everyone comes into almost daily contact. Yet so many of its uses are in concealed places or in unrecognizable forms that frequently we are not aware of its presence. When we start our automobiles, we rarely think of the lead storage batteries that activate the starting motor. When we make a long distance telephone call, nothing reminds us that our voice is carried for miles over wires sheathed in lead. When we look at a beautifully painted house, it seldom occurs to us that the paint had its origin in a lead mine. As you read this magazine, do you think of the lead-alloy type from which it is printed?

Yet scarcely an industry, scarcely an individual is without almost constant dependence on lead in one of its hundreds of uses and many forms.

Lead, too, has a long and honorable history. It is one of the oldest known metals, evidently well known in Biblical times for it is mentioned in Exodus and elsewhere in the Old Testament. Many of lead's uses have persisted through centuries. For instance, in the days of the Pharaohs, it was used to glaze pottery, and to make solder and ornamental objects just as it is today. Modern lead plumbing had its origin in the lead pipes of the Egyptians and Romans. Sheet lead waterproofing such as we find in 20th Century stall showers had an ancient counterpart in the lead linings used for the floor of the hanging gardens of Babylon. Lead roofs still exist that were erected in medieval times, and white lead, the best known of all paint pigments, has been known for 2000 years.

On the other hand, some of lead's uses are extremely modern in development. Storage batteries, cable sheathing, ethyl gasoline and leaded lubricating oils, collapsible tubes for such things as glue, foil, bearing-metals and other uses of lead are all of modern origin. Most recent of all is the inclusion of lead in steel to improve steel's machinability.

These vast and diversified uses of the heavy, gray metal require hundreds of thousands of tons a year to satisfy them in the United States alone. Consumption of lead in this country in 1939 was almost 700,000 tons and reached an all time high in 1929 of nearly a million tons. In addition to consuming more lead each year than any other country, the United States is also its leading producer and has mined enough lead to take care of all its own requirements in recent years. Outside the United States, Mexico, Australia, Canada, Germany, Silesia, Spain, Burma, northern Africa, and, more recently, Argentina and Peru are important producers.

In the United States, Missouri mines the most lead, followed by Idaho, Utah, Oklahoma, Kansas, Colorado and Montana, and to a small extent other states.

With the exception of the lead mined in southeastern Missouri, it is usually found associated with recoverable quantities of other metals, notably silver and zinc. In fact, there was a time when lead was frequently considered a by-product of silver mining, but as lead's

Surface plant of a large silver-lead mine in northern Idaho.

Loading an ore car underground at a silver-lead mine in the Cour d'Alenes, Idaho.

industrial importance and value have increased that condition has changed.

There are many minerals containing lead found in nature, but the most important commercially is galena, lead sulphide, an easily recognizable, brightly metallic mineral. Other lead minerals of commercial importance are the carbonate, cerussite, and the sulphate, anglesite, but neither is found to anywhere near the extent of galena.

Lead is mined almost exclusively by underground methods. The Missouri deposits are relatively shallow flat lying ore bodies of considerable thickness, while the western ore bodies are in general fairly narrow veins, often steeply pitching and in some cases extending to considerable depth.

The miner is fortunate indeed who finds and mines ore rich enough in lead to be shipped directly to the smelter without intermediate processing. Ordinarily he is not so lucky. After costly prospecting with diamond and churn drills and expensive development work consisting of shaft sinking, drifting and cross-cutting, he is lucky if he finds payable ore. Even if an ore is phenomenally rich in lead, it must be subjected to special processing if it contains appreciable amounts of copper and zinc, as it often does. Usually a miner must struggle with low grade ore, perhaps as low as 3 per cent lead, and attempt to mine and treat it at a profit. One of the largest lead mining companies mines about 3,000,000 tons of ore to get 100,000 tons of lead. In such cases, large amounts of waste rock, or gangue, must be mined along with the lead-bearing mineral, and much of it must be removed at the mine to reduce shipping costs to the smelter, and smelting charges. Nearly all zinc-bearing minerals must also be separated from the lead at the mine in order to avoid being penalized by the smelter for the zinc content which is classed as an "impurity" because it interferes with the lead smelting operations.

Lead ore is concentrated in a mill at the mine, or perhaps in a custom mill nearby which concentrates the ore from a number of mines. It is first crushed extremely fine in huge crushers, to particles less than 1 mm. in diameter sometimes. The lead-free waste material is then separated from the lead-bearing mineral by one or a combination of processes. Gravity methods such as vibrating tables and jigs may be used, or the remarkable flotation process which seemingly defies gravity. In the gravity methods, the finely crushed ore is mixed with water, the heavier lead-bearing minerals settling to the bottom and the lighter waste rock being taken off at the top.

The flotation process is applicable mainly to sulphide ores, fortunately the most common type, or to oxide ores which have received a preliminary sulphiding. Briefly, the ore is crushed extremely fine and diluted with, say, four times as much water, then agitated violently with air in a tank to which a fraction of one per cent of pine oil, with or without small amounts of other chemicals, has been added. A froth containing most of the metallic constituents of the ore forms on top of the tank while the valueless gangue remains at the bottom. The froth flows from the tank and is dried.

Flotation practice has reached such a stage of perfection that extraordinarily efficient work is being done, not only in extracting a single mineral from an ore, but also in separating the several minerals in so-called complex ores, for example, an ore consisting of an intimate mixture of lead, copper and zinc minerals. For years the treatment of many complex ores baffled metallurgists, but with selective flotation as a tool, many mineral deposits considered practically worthless a few years ago have developed into important lead mines. Furthermore, many straight lead ores formerly believed too low grade for economical treatment have suddenly become profitable possibilities, adding greatly to the world's available lead reserves.

Lead concentrates when they leave the mill contain 40 per cent and upwards of lead. The richer the lead content the better, for it reduces transportation and smelting costs. Smelting is a continuous operation gen-

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Lead Blast Furnace.

Earth Processes

● **By Timothy C. May, Ph. D.,** *(Catholic University)*
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This is the second of three articles by Dr. May on the general subject of Geology. The first, "The Scope of Geology" appeared in our December, 1939, number.

In the present paper Dr. May first outlines the hypotheses that have been advanced concerning the past history of the Earth and the Solar System. He then shows how the formation of an atmosphere and oceans on the Earth has been explained; how the surface of the Earth is being modified continuously; how rocks are formed and destroyed; how soil is made, water-sifted, and transported; how coastlines are modified; and how earthquakes, volcanoes and avalanches are caused.

The concluding article of this series, "Applied Geology," will be published in an early number.

●

The planet upon which we live is one of nine planets which revolve about the Sun. Compared to the Earth, the diameter of Mercury and Mars is about half as great; Venus is about the same size; Uranus and Neptune have a diameter slightly more than four times as great; Saturn ten times as great, and Jupiter, the largest, twelve times as great. All the planets revolve about the Sun in about the same plane. The orbits of Mercury and Venus lie within that of the Earth and are known as the interior planets; outside of the orbit of the Earth are found successively Mars, Jupiter, Saturn, Uranus, and Neptune. Then far beyond them all, alone in the outer void, is tiny mysterious Pluto.

Beginning about February 23 and lasting through the first week in March of this year, a unique celestial show was presented. The five brightest planets in the solar system lined up in a formation resembling a necklace of glowing jewels. Mercury, Jupiter, Venus, Saturn, and Mars, in the order named, formed an undulating line, with Mercury nearest the western horizon. The chain was visible right after sunset practically all over the world. The spectacle amounted to having five evening stars on view simultaneously.

The lure of the stars has affected man from the earliest historic times. The ancient Greeks thought that the Earth was the center of the Universe and about which everything else revolved, but since the time of Copernicus the Earth has been known to be merely a planet which revolves about the central Sun. Our Earth is about 93,000,000 miles from the Sun. In addition to rotating on its axis once every twenty-four hours, the Earth has a speed of more than 1,000 miles a minute on its yearly path of 580,000,000 miles around the Sun. The diameter of the Earth is about 7927 miles at the equator, and about 7900 miles from north pole to south pole. In other words, it is not a sphere; it is an oblate spheroid, bulging at the equator and flattened at the poles.

The Earth, or geosphere, is composed of matter in three different states: gaseous, liquid, and solid. The *atmosphere*, or air envelope, is a gas. The *hydrosphere*, or water envelope, is a liquid. The *lithosphere*, or rock sphere, beneath our feet is a solid. Below the solid crust and extending to the earth's center is the *centrosphere*. Aside from the Biblical story of creation, many hypotheses have been advanced relative to the possible past history of the earth and the solar system. Laplace, a French astronomer, in 1796, pictured the solar system to have evolved from a gigantic nebula which extended from our sun far beyond the remote planet Neptune, which is over two billion miles away. He pictured this vast gaseous nebula to have been rotating in space and gradually contracting inwards towards what is now the sun. As it did so, a series of equatorial rings were formed similar to those that one can observe about the planet Saturn. Finally these rings broke and globularized, each giving rise to a planet. Some of the planets themselves formed rings which in turn broke and globularized giving rise to the moons or satellites of which the earth has but one while others, like Jupiter, have several. In the masterly hands of Laplace, this theory, which was the outgrowth of many similar previous theories, found wide acceptance and for a while held undisputed sway among the theories of earth evolution.

More recently, other theories have been advanced which seem to suit the physical facts involved better than the nebular hypothesis of Laplace. Among these is to be found the Planetesimal Hypothesis advanced by the two American scientists, Thomas Crowder Chamberlin and Forest Ray Moulton. In this theory two stars are supposed to have passed sufficiently close to one another to have caused the tidal disruption of at least one of them. This star, our ancestral sun, had an enormous mass of material drawn from its central portion in the form of a bolt, and it was set in motion. In order to balance the forces in the revolving mass, a bolt was shot out upon the diametrically opposite side and each was deflected in a direction opposed to the motion, thereby forming a spiral nebula of which there are many examples in the present heavens. The material in the bolts is supposed to have been finely divided solid matter, to which the authors have applied "planetesimals." In existing spiral nebulæ the arms, which correspond to the bolts referred to above, possess certain areas of concentration or "nuclei" which are supposed to be planets in the making. In other words, the finely divided planetesimals, or star-dust, rained in upon the nuclei in the arms of the ancestral nebula, thereby forming the various planets of our solar system, while the central mass concentrated into our sun. One of the nuclei was destined to become our earth, and as it

gradually "swept the skies" of planetesimals it was able to hold within its gravitative control another nucleus which was not so successful in drawing material, and thus this planetesimal knot eventually became our moon.

The methods of the two hypotheses in accounting for the attainment of an atmosphere and oceans upon the earth is quite different. Laplace thought that as the earth gradually contracted from a gaseous to a solid state the atmosphere, surcharged with steam, was gradually left behind as a gaseous envelope. Finally, when the earth cooled down sufficiently to permit the moisture to be rained down upon it, the oceans were formed and the uncondensible material was gradually evolved into our present atmosphere. The planetesimal hypothesis, on the contrary, states that the materials out of which the atmosphere and hydrosphere were to be formed were only acquired in the later periods of accretionary growth during the period of "sweeping the skies." According to Chamberlin and Moulton, the moon possesses no atmosphere because it never grew sufficiently large to attract and retain one. Stated differently, the earth was just as atmosphereless when it was the size of the moon as is that body at the present time. The same argument is used to explain the acquisition and retention of the moisture that was ultimately to form the oceans.

Another theory is that of Jeans and Jeffries, known as the Tidal Theory. The tidal theory assumes that a star, larger than the sun, almost came into collision with it. The passage of this star was so close and so rapid that the incandescent matter it displaced by tidal action from the sun, with the departure of the star, remained in the solar envelope. The far-flung attenuated and incandescent matter displaced from the sun's body evidently condensed into molten bodies and rapidly assumed the primary form of the various planets, from the outermost, Pluto, to the nearest, Mercury. In the case of the earth it is thought that solidification probably ensued within 15,000 years of the sun's disruption, and that, almost in the act of solidification, the disturbing tidal influence by the sun, causing disruption by resonance, led to the birth of the moon from what is now the hollow of the Pacific. All theories agree that the materials of the planets were derived from the sun, which previously had been an encumbered star.

However, it really matters little how the atmosphere and the oceans were attained so long as we have them, for it is upon them that much of the sculpturing of the earth's crust depends. When all is said and done, the science of geology concerns itself largely with the study of merely the earth's uppermost crust, for that is the only part with which we are in intimate contact. The deepest mine penetrates the crust little more than a mile, and the deepest well boring is in the vicinity of 15,000 feet. Even in the areas of most profound denudation it is questionable whether rocks are exposed that were ever more than 20 miles from the surface at any period of their existence. When this is compared to the 4000 miles that must be penetrated to reach the center, it is obvious that man's direct information barely scratches the surface. Our ideas regarding the nature of the earth's interior are thus entirely hypothetical; yet the deductions made are based upon a great mass of physical, chemical, and seismological data that should certainly give them a reasonable aspect of legitimacy.

Man's knowledge of the earth's interior, though it cannot be determined by direct observation, is based upon a number of physical and astronomic observations. In the first place, the average density of the earth has been determined to be about 5.52. A number of scientists, basing their judgment upon thousands of chemical analyses of rocks representative of the earth's known crust, have come to the opinion that the average density of this is about 2.7. We are therefore faced with two possibilities in our attempts to explain the discrepancy between these two figures. If the interior is granitic like the crust, the rocks within must be compressed to about one-third of the volume that they possess at the surface; if, on the contrary, they cannot be so highly compressed, they must consist of materials much denser than those with which we are familiar at the surface. The work of dependable experimental scientists leads us to believe that rocks of the average type such as tend to make up the earth's surface, in spite of the enormous pressures that must exist in the earth's interior, could hardly be compressed sufficiently to fulfill the first requirement. On the contrary, assuming the earth to have grown by the infall of cosmic dust, it is logical to expect that the nature of the material rained upon the primordial earth would approximate the matter that it still acquires in the form of meteorites.

Meteorites, or "shooting stars" as they are popularly called, may be divided into three groups: the stony type, or aerolites, which approximate the rocks of the known crust in composition; the siderites, or metallic type, which consist largely of an alloy of nickel and iron; and a sort of hybrid type between the two, known as sidaerolites. The average density of the stony meteorites approximates that of the earth's crust; that of the metallic meteorites approximates that of iron, which is 7.4. Thus, we are constrained to believe that the core of the earth is metallic and consists largely of iron.

With these few brief remarks let us dismiss the more hypothetical aspects of the earth's condition and confine our attention to the surface about which we have much more tangible data. The surface of the earth is undergoing continual modification through the agency of the atmosphere and the moisture it contains. The process by which this is accomplished is known as erosion, and by it mountains are worn away and vast quantities of sediments are aggregated. The processes of erosion are punctuated by periods of unrest during which earthquakes and volcanoes abound, and mountains are re-elevated. Let us confine our attention to the subject of rock destruction and investigate by what processes rocks are worn away and what becomes of the products of rock destruction.

Soil is a product of rock decomposition. Granite is composed of two essential minerals and several accessory minerals, the essential minerals being quartz and feldspar. Quartz is among the most resistant of minerals and is usually found little changed in the result-

ing soil. Feldspar weathers more easily into a soluble and insoluble portion. The soluble portion consists largely of potassium carbonate, an important plant food. The insoluble portion is largely clay. Residual quartz gives to soil a certain porosity without which subsurface circulation would be impossible; on the other hand, the clay provides a binder to permit a sufficient amount of water retention. Nature not only provides a suitable medium in which to grow plants but provides food for their nourishment as well. Were it not for rock weathering plant life would be more or less impossible, and without plants we would soon be deprived of food, for most of our cattle live on a vegetarian diet.

Much of the products of rock decomposition, however, is not permitted to remain *in situ*. The subject of glacial transportation has already been touched upon in a previous article, but the complete story of water transportation has not been told. Residual soil is often assorted into its component parts by moving bodies of water to form sand on the one hand, and clay on the other. The familiar sand which forms the bulk of the beach deposits bordering the ocean and the larger lakes consists largely of quartzitic material. Sediments of this nature, when consolidated by the pressure of superincumbent material and cemented by infiltrating material become what is known as sandstone. The clays are lithified into more impervious materials known as shales. These two types of stone form the bulk of the sedimentary rocks. Throughout geological time many thousands of feet of sandstones and shales have been laid down. These act as monuments for the longevity of geological time. The history of the earth is indelibly written in these masses of sedimentary rocks.

The power of the ocean as a means of rock destruction cannot help but engross the attention of one who observes it. The whole Atlantic seaboard furnishes examples of the mightiness of oceanic power. The tides change twice in 24 hours and 52 minutes, and in so doing large quantities of sediments are drawn to the seaward only to be driven back toward the land. During stormy periods the waves, lashed to a fury by the wind, drive huge blocks of detached rocky material against the exposed coastline, battering it and grinding it down. By this means the coast is sculptured, giving rise to sea caves and beaches. In some places forbidding shorelines are formed which are a menace to the unwary mariner who ventures too close to their treacherous shores, such as the coasts of Maine and of Scotland. In other places the coastline is worn down to a plain which dips gently into the ocean. The Atlantic coast from Massachusetts to Florida is of this type, and although these appear much less forbidding than the rock-bound coasts alluded to, they may be just as hazardous to shipping. The coast of New Jersey is a good example of this. Though very low, this coast has shoal water a considerable distance from land where boats may be beached far out from shore. Mariners have learned to respect the Jersey coast and Cape Hatteras, and in spite of the utmost vigilance this piece of coastline still proves the graveyard of many sturdy ships.

As the products of land erosion gradually work their way to the sea, the floor of the continental margins of the ocean becomes littered and heavily burdened with land debris. It is thought that the continued weakening of the land areas as a result of this process of wearing down, coupled with the continued overloading of the ocean floor near the continental borders, finally overcomes the isostatic balance between land and sea. There is a tendency for the ocean floor in these areas to be gradually depressed with the result that the vicinal land masses, in order to make room for the down-moving material, are severely buckled and thrown up into mountain masses. Suffice it to say that mountain ranges most often parallel the coastline and lie near to the continental flanks. In this respect North America is a particularly good example. If you will look at any physiographic map of this continent you will be struck by the fact that the Rocky Mountains and the Coast Ranges of the West parallel the western margin while the Appalachian System parallels that of the East.

The subject of mountain formation is one of great interest, for the processes of erosion which tend to destroy them almost as soon as they are completely elevated, expose to the eye of the geologist many features of structures that otherwise would remain covered by later formations. Along the flanks of mountains we find sedimentary rocks containing marine remains tilted many degrees from their original position of horizontality, thus affording a cross-section of rocks some of which were buried many miles below the surface before the processes of mountain-building began. Veins of valuable ore, formed many feet below the surface, are again brought to the light of day so that they become available to man's efforts to mine them. Often the terrific pressure to which they were exposed during the folding process exceeds the elastic limit of the rocks involved and they develop huge fissures along which one block moves upon the other. This process is known as faulting, and the shocks caused by the sudden slippage of such huge masses of the earth's crust are manifested to man in the form of earthquakes. These faults may be so deep-seated that parts of the earth's highly heated interior may be permitted to melt and discharge through them giving rise to volcanoes. It is a noteworthy fact that practically every volcanic and earthquake disturbance is associated with areas of recent crustal disturbance and lies along major fault lines.

Volcanic disturbances are among the most spectacular of the earth's manifestations of internal unrest and the most destructive to man and his work. The United States has one active volcano, Mount Lassen in northern California, where eruptions began in May, 1914. Italy has been famous for her volcanic woes ever since the destruction of Pompeii and Herculaneum in 79 A.D. Vesuvius, which is a short distance from Naples, still seethes and threatens humanity. Stromboli rises majestically from the Mediterranean as a sheer cone of volcanic ash with a cloud of steam continuously hovering over its top. Etna has only recently spread its carnage of fire and destruction over the island of Sicily. In 1902, Mt. Pelee, on the island of Martinique in the

Continued on Page Eighty-six

The Scientific Church

● **By Reverend Thomas J. Quigley, M. A.** *(St. Vincent College)*
SUPERINTENDENT OF CATHOLIC SCHOOLS, DIOCESE OF PITTSBURGH, PITTSBURGH, PA.

In his address of welcome to the teachers who attended the recent Duquesne University Conference for teachers of science, Father Quigley discussed briefly the relationship between science and religion.

His ideas are clear cut; his expression of them plain. We are glad to be able to present them to our readers. "The Church has forever encouraged the search for truth and for clearer explanations of men and the universe. But, unlike so many idolators of science, she has never felt that science alone, or philosophy alone, or any one branch of human scholarship could solve all the problems of time and eternity unaided."

●

Recently I had occasion to discuss with the Curator of Education at a Museum in a large city the arrangement of a schedule of lectures in the Natural Sciences to be given to Catholic high school pupils. During the course of this conversation the Curator remarked that the Museum had interesting lectures and exhibits in paleontology, but feared that the Catholic schools would not want these included inasmuch as they, to quote the Curator, "included a lot of evolution." The Curator was surprised to learn that these lectures in paleontology not only could, but should, be included in a Catholic course, and that any Catholic teacher who could not interpret for her children the Catholic viewpoint on evolution, had no business teaching science in a Catholic high school. As a result of our conversation I have some hope that the Curator has been divorced from the false notion that Catholic scholars are backward and hide-bound fundamentalists in the matter of scientific investigation. Such notions, too prevalent in the minds of non-Catholic scientists, make a Conference of this kind especially significant, and cause me to regard an invitation to a matter of great moment.

I am pleased to be permitted the honor of welcoming you here today because it affords me the chance to add my small testimony to the written record which denies such calumnies of Catholic scholarship. Your presence here in so large numbers is a denial of the absurd belief that the Catholic teacher or scholar is uninterested in, or afraid of, the study of the natural sciences. Fortunately, this belief is held today only by some of the lesser lights in the scientific world, those who are inclined to adore science as a god. Its absurdity becomes more apparent to serious men of science as they realize more and more how futile is the hope that science alone will answer all the questions proposed by man's inquiring mind, and establish at long last an Utopian Social Order.

The Church is not afraid of Truth. She loves the truth with a purer, a more unselfish, and a more impassioned love than does any Royal Academy of Science. For the Church and the Catholic scholar the complete truth is God, and any avenue of approach to God, to a further understanding of the Divine Mind, and to a consequent deeper love of the Divine Heart is something devoutly to be desired. The Church has forever, therefore, encouraged the search for truth and for clearer explanations of man and the universe. But unlike so many idolators of science, she has never felt that science alone or philosophy alone, or any one branch of human scholarship could solve all the problems of time and eternity unaided. She has never regarded man in a narrow sense as being a thinking mechanism alone. She regards him as a thinking, willing, judging, reasoning, feeling being; a complex being composed of matter and of something else that is not matter; an unpredictable being of thought and emotion; motivated by forces of heredity and forces of environment and still capable of resisting and of arising above either. She is not surprised nor afraid of anything that may be discovered about man or the universe, but knowing man so well, she is slow to accept each new fact presented by scientific research. Long years of human experience have taught her that caution is a virtue and that man, even scientific man, as well as woman, is fickle. Her caution and her unwillingness to accept everything and anything as established truth simply because some scientific investigator has said so, has caused her to be styled the enemy of scientific investigation. Her refusal to believe that science alone can explain everything, has led some to the absurd conclusion that she believes science can explain nothing. The scientific world of today, which shows signs of having passed through its rash and exuberant youth to a more humble and steadier maturity, is not so ready to condemn the caution of the Church, and is even willing to listen with composure to her teaching.

Truth is a composite of ideas and ideals, information and facts, skills, attitudes and evaluation. Scientists themselves admit today that the contribution of science to truth is informational and factual. The Church has never denied this but has always maintained that, while science serves a most important service in unraveling the facts of nature, science has little if any right or facility in the realm of ideals, attitudes or evaluations.

Thus the Church has been eminently scientific in her search for truth, for she has sought it everywhere, not only in science, but in art, in philosophy, in theology, in history, in sociology. She has not scorned any field of human learning, as so many scientists have scorned philosophy and theology and art. She has followed the advice of Thomas Huxley and sat down before fact as a little child, even before the fact of the spiritual. She

has never sniffed at the material as Huxley sniffed at the spiritual.

If there is any foundation to the accusation that her thinking is prejudiced because she starts from an *a priori* assumption of the existence of God, there is more foundation to the accusation that some investigators begin from an *a priori* assumption that there is no God, no miracle, no supernatural. It is not Huxley's scientific humility, but human pride that denies the very possibility of existence to any being or beings superior to mere man. The Church has done more to propagate the truth of the dignity of man than any other organized body, and yet she does not assume that man is the "be all and end all" of everything.

Far from being the enemy of science the Church has been and still is an example of what a scientist ought to be, cautious, slow moving, humble, taking the long view, sitting down before the fact as a child, more anxious to see big than to look big.

You scholars of the Church need to follow her example. There is truth in the accusation that individual Catholics have not always devoted as much time and serious effort to scientific research as their non-Catholic confreres. They have not followed the example of their Church and in their anxiety to counteract the exaggerated claims of science, have ended by neglecting science altogether. Because recent advancements in science were made by scholars outside the Church, some Catholic scholars have shied away from the study entirely. Such an attitude is entirely out of character for a Catholic, out of keeping with the mind of the Church, and responsible for the false impression and often for the poor showing of Catholic scholars in the scientific world. The natural sciences must be given an important position in every Catholic school, and Catholic students must be encouraged to pursue scientific research. As Catholics they have the proper spirit and background to be safe scientists. They need to learn more about the techniques of research and to thrill at the adventure of a life devoted to scientific search for truth. It is the duty of you teachers to so guide and inspire them that they may take their rightful places along with other great Catholics whose scientific discoveries have made their names part of common speech. Modern astronomy is Copernican; our calendar is Gregorian; iron is galvanized; electricity is measured by amperes and volts and coulombs; cattle is bred according to Mendelian principles; milk is pasteurized; roentgen rays are familiar to every scientific experimenter. Shall you science teachers not then be able to inspire and encourage your pupils to great heights, following the leadership of such Catholics as Copernicus, Gregory, Galvani, Ampere, Volta, Coulomb, Mendel, Pasteur and Roentgen, just to mention a few?

It has often been said that a Catholic properly trained makes the greatest artist, for art requires that a man be disciplined and have an appreciation of spiritual values. Perhaps I may be pardoned if I say that a Catholic properly trained makes the greatest scientist, for a scientist needs discipline, humility and a sense of spiritual values. It is your office to mold such men and women. It is a very noble office. ●

Elements of Human Physiology

By MIRIAM SCOTT LUCAS, B.S., Ph.D. Lea and Febiger, Philadelphia, 1940, $4.50. 400 pp. Illustrated.

I think that a really new book on elementary human physiology has been published.

This is no mere outline of structure that is put jerkily through its paces, marionette fashion, to simulate the vital function that is the excuse for the mechanism. Dr. Lucas has succeeded in blending the body and its behavior so thoroughly and yet with such nice discrimination for detail that the reasons for what our bodies do or what happens to them are made intelligible as coordinated vital processes.

Elements of Human Physiology strings together structure, function and common physiological experience in a way of its own. The explanation of the many little functional happenings, so commonly omitted from similar texts, are to be found here on almost every page. This serves not only the better to fix the details in the reader's mind but should as well give him a sense of practical intellectual achievement.

Dr. Lucas, having just come through the grind of creation, probably does not, at the moment, know whether she has written well or badly. I feel very certain, however, that her readers will not be long in assuring her that she has done as she desired.

R.T.H.

●

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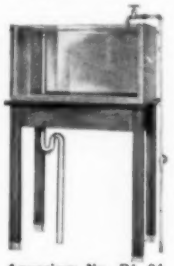

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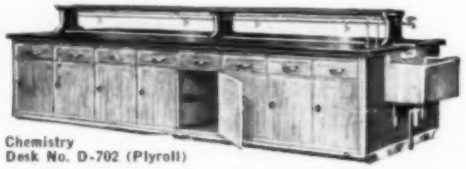

Chemistry Desk No. D-702 (Plyroll)

Chemistry Club

Continued from Page Sixty-seven

visible to the entire lecture hall, and the use of flasks adds interest. This technique could be extended to reactions involving precipitations. It should prove effective in collodial demonstrations.

The formation of chlorides, sulfides, and oxides of metals such as iron, zinc, copper and magnesium in a dark room has been found to be much more impressive than the usual method of preparing them in the daylight. This technique may be applied to demonstrations with thermit also.

The use of large flasks for the production of chlorine, bromine, iodine vapor, and nitrogen dioxide is recommended. Special caution must be taken to prevent the escape of any considerable volumes of these gases into the classroom. A sheet of white cardboard should be used as a background when the flasks are exhibited.

Many classes are so large that time is not available for pupils to come to the desk to inspect the products of reactions observed. Samples are usually passed among the pupils for their inspection. It is just as important that pupils become acquainted with the reagents used. Samples of solid reagents can be put in small beakers and passed among the pupils. Caustic solids and dangerous liquids can be placed in stoppered bottles and put in a tin cup before passing around.

Where teachers are forced to use demonstration tables no higher than the pupils' desks, visibility can be improved by using a small table on the desk. This should be done even if the teacher has to stand on a low stool.

Some schools have found the use of micro-projectors, bi-focal microscopes and projection machines valuable for increased visibility. There is a tendency for these expensive aids to gather dust and rust rather than to wear out. Where they are available, careful study should be made to promote effective use.

Teachers and laboratory technicians are urged to make apparatus for demonstration purposes as large as practical. Sometimes it is advisable to make apparatus in sections that can be quickly assembled. Less storage space is required when apparatus is made in sections. Wherever it is practical to do so, apparatus of commercial size should be obtained. Examples of such apparatus are the acetylene torch, gasoline engine, parts of motors, cylinders for transportation of gases, carboys for transportation of acids, small stoves, etc.

An example of an apparatus that can be constructed is one to show the thermal expansion of metals. Instead of the few short rods that some demonstrators use, wires of the metals to be tested can be strung across the room and heated with electricity. Apparatus for showing the difference between a drying and a non-drying oil should be large enough to permit soaking a square yard of cloth in each oil and allowing it to hang in the air for a week.

Apparatus that has interest because of its convenience and its safety features include the electric heating devices that may be used for heating nails or coke in the preparation of hydrogen or water gas. A recent demonstrator used a coil of platinum wire inside of his apparatus for heating ammonia gas before he catalytically oxidized it. Another device is used instead of flints or matches to light gas burners. All that is needed is a source of current and a coil to raise the voltage high enough to give a fat spark. Care must be taken to see that the current is not strong enough to be dangerous to pupils. This device uses one wire attached to the gas burner through the rubber hose. A second wire is attached to the desk in an out of the way place. A light is obtained by turning the gas on and bringing the end of the burner barrel in contact with the second wire at an exposed point.

Instead of larger apparatus such as was suggested for teacher demonstrations, an entirely different technique for pupil experiments has been suggested to the Club by a professor of micro-analysis. He emphasized the use of small apparatus where individual experiments are to be performed. Reagents are measured in drops by means of a medicine dropper rather than in milliliters. Eight-milliliter test tubes are used instead of the standard thirty milliliter tubes for the collection of gases and for precipitations. A hydrogen generator is made with a two ounce bottle or a fifty milliliter flask. A thistle tube for this generator can be made by enlarging one end of a standard size glass tube. This thistle tube will be satisfactory for introducing reagents by the drop. A small scoop should be constructed for measuring solid reagents. A condenser can be made by passing a small glass tube through a tube of half inch diameter. The heating of small flasks or generators can be accomplished by cups of boiling water or by means of small micro-burners.

This approach to the problem of pupil experimentation has many advantages. The cost for supplies is considerably lower. The time required for experiments is shorter. Pupil experiments are much safer where small quantities of reagents are used. The laboratory is much cleaner where micro-quantities are used. The work of the laboratory squad is usually less per experiment. The air in the laboratory is contaminated less by such gases as chlorine, bromine, iodine vapor, sulfur dioxide, hydrogen sulfide, sulfur trioxide, nitrogen dioxide, etc.

As a rule, pupil interest increases as the number of pupil experiments increases. This technique enables the teacher to schedule many more pupil experiments. Pupils are just as interested in micro-experiments as in the usual type. If pupils are started on the small apparatus, they will not have to compare or contrast the types of apparatus.

Pupil experiments are psychologically sound in that they provide vivid vicarious experiences which force pupils to concentrate more on the work at hand. There is little day-dreaming in a laboratory where pupils are experimenting. Pupils acquire valuable training in manipulations of materials and apparatus. This technique provides an excellent opportunity for teaching the methods of science also.

In the past, demonstrations before the Club have been made without pupil participation. Circumstances have been responsible for this situation. Pupils are not avail-

able when the Club meets. A few bright pupils have given demonstrations, but there have been no demonstrations before a class of pupils in recent meetings of the Club.

However, demonstrations by teachers before a class of pupils are highly recommended. This technique for club programs has been used by other metropolitan groups with considerable success. It permits the demonstrator to present his experiment in approximately the same situation that he encounters in the classroom. Young teachers can study the demonstration and the practical application at the same time. ●

Earth Processes

Continued from Page Eighty-two

French West Indies erupted, destroying the entire town of St. Pierre and nearly all of its inhabitants. The explosive eruption of Krakatoa, in the East Indies, was so violent, in 1883, that the greater part of the island was shattered. Boats now sail where parts of the island once existed. Many active volcanoes are found in Central and South America. They lie along the axis of the mountain chains with such conditions of regularity that Colonel Charles Lindbergh is said to have used them as night beacons on his "good-will" flight to the southern Republics.

All volcanoes are not violent. Among the quiet type there are those of Hawaii. The island of Hawaii consists of a vast mass of lavas surmounted by five cones—Kohala, Mauna Kea, Hualalai, Mauna Loa, and Kilauea. Volcanoes of this type give rise to quiet outflows of liquid lava, which are very hot and highly fluid. Mauna Loa, now active, exceeds all in size and activity. Its crater is at an elevation nearly 10,000 feet higher than Kilauea.

The shock of an earthquake grips man with fear. It usually comes without warning. It has been definitely established that earthquakes arise from a quick shock produced by a sudden yielding to strain by the rocks in the earth's crust.

The sociological effects due to earthquakes are great. Buildings are damaged, fires start in cities and towns because the water mains have been broken and fire-fighting apparatus destroyed, and, usually, thousands of lives are lost due to fire and falling structures. If a building is constructed so that it can rock or slide upon its base, all of the movement will not be transmitted to the structure and the damage will be less. If a building is not too high and is well constructed, it will not be seriously damaged beyond cracking of the walls, breaking of glass, and destruction of chimneys.

The geological effects from earthquakes are of minor importance. Loose mantle soil and debris are ruptured. Landslides and avalanches in mountain regions are started. A variation of the flow of water and even the formation of new springs have been observed. Some think that earthquakes are a protection to man because, since the vibrations relieve stresses and strains in the rocks, the earthquake may be a safety valve that prevents even greater catastrophes. ●

Essay Contest

Continued from Page Sixty-one

Schools which expect to submit essays in this contest should so inform the Director of the Science Conference, Duquesne University, Pittsburgh, Pa., by letter or postcard, on or before January 1, 1941. No obligation is incurred by sending such notice.

The rules which are to govern the contest are here given.

Rules for Essay Contest

Subject of the Essay: *Science Protects Our Drinking Water.* No other subject may be used.

1. Any student enrolled in a Catholic high school, junior high school, or preparatory school, who has not yet completed four years of high school work, is eligible to enter this contest. It is not required that the student shall be enrolled at present in any science course. Catholic students attending public high schools may not compete.
2. Each school may submit *only one* essay.
3. Essays should be typewritten, double-spaced, with good margins, on one side of the sheet only. Legible hand-written manuscripts may be accepted. Essays are to be in essay form. They may not exceed 1,200 words in length. Longer essays will be rejected without reading. All direct quotations must be inclosed in quotation marks and references given. Long quotations are not acceptable. Essays may not be illustrated nor accompanied by charts or exhibits.
4. Each essay shall be the individual work of the student. In its final form it may receive only such supervision as is given in the usual written examinations of the school.
5. A plain, sealed envelope, firmly attached to the essay, must contain the full name, age, and home address of the contestant, the actual number of words in the essay, the name and address of the school, and the name and title of the supervising teacher. No further identification of the writer or the school may appear on the essay or the envelope.
6. Essays must be forwarded by the principal or the supervising teacher with the statement that the essay was written under supervision and that it is the original work of the student.
7. Essays for this contest must be mailed to the Director of the Science Conference, Duquesne University, Pittsburgh, Pa., not later than *February 1, 1941.* Essays will not be returned. ●

Science Projects

Teachers are always interested in the work done and the teaching methods employed by instructors in other schools. Teachers of science may be greatly aided by studying the student projects that have been found workable and useful by other teachers. An exchange of ideas is helpful and productive of good. Duquesne University, therefore, invites teachers everywhere to select some of the more successful science project material they have used or developed, and submit it for display at the Science Conference in February, 1941.

The projects submitted need not be original; neither need they necessarily be elaborate or expensive. They may be in the form of home-made apparatus, collected materials, herbaria, specimens, displays, teaching devices, models, carvings, drawings, photographic work, special charts, etc. They may be connected with any high school science.

Each display should be labeled with the full name and address of the school, the name of the teacher, and the name of the student. They should be addressed to the Director of the Science Conference, Duquesne University, Pittsburgh, Pa., and shipped so that they will arrive on or before February 12, 1941.

All project material will be returned, carriage paid, to the cooperating schools after the Conference. ●

Extracurricular Program

Continued from Page Seventy

tensive work in this field is conducted by members of the Botany Department, so emphasis is placed on the utilization of these materials.

A few animals are kept on display as a matter of interest and study. Students and school children care for them. These include red and flying squirrels, field mice, snakes and amphibia, tropical fish, and occasionally injured birds which have been brought to the office.

Special Summer Activities

Since no regular summer session or camp is conducted by the College, the Naturalist is free to plan any summer work he may choose. An attempt has been made to participate in activities which would help to promote the winter nature program or to assist in the general nature and conservation program within the state or region.

In the summer of 1939 the writer traveled to the Labrador Peninsula and made a study of the natural history of the North Shore of the Gulf of St. Lawrence. Small mammals and plants were collected and many pictures were taken of the bird life there. Several articles summarizing these studies have been prepared and numerous talks about the trip were given.

During the summer of 1940 a full program of teaching of natural history is planned. During June the writer will assist in teaching the field biology course and the extracurricular nature study at the Oglebay Institute at Wheeling, West Virginia. This work is being offered there for credit for the first time this year, to assist in the state program of teacher training in conservation education. During July and the first half of August, the writer will teach in the regular summer session of the Plymouth State Teachers College at Plymouth, New Hampshire. A course in natural history, one in conservation, and extracurricular activities similar to those conducted at Dartmouth will be given.

Summary

Dartmouth College has successfully launched an extracurricular program of natural history, and the objectives originally outlined by a far-sighted planning committee for keeping the work free of administrative details and available to all students and members of the College community, have been realized. A varied program of activities is conducted which caters to most of the natural history interests in the College and community. Although many activities have been engaged in, an attempt is being made to plan each one so that it shall be of lasting value as well as of current interest. The first years seem to have demonstrated the desirability for continuing this unique and interesting experiment in extracurricular education. ●

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Junior Academy

Continued from Page Seventy-three

ities are offered for direct participation in club activities in the community. Students majoring in science certainly should have first hand experience in science club work before going to their respective schools. This will lessen the many requests for constitutions and by-laws, and suggestions for science projects and programs. *Such assistance given by any center may retard creative work and interfere with the club meeting the immediate needs and the interests of its members.*

Conclusions

First, that the outstanding need is the cultivation of a genuine *science consciousness* which when acquired will solve many of the problems now confronting the work of the Junior Academy. It is imperative that the club sponsors as well as the other science teachers and the school administrators acquire a genuine consciousness for science.

Second, from the fifty-four replies received from the ninety-nine letters written, it is obvious that the Junior Academies need to be registered in some official office where authentic data may be secured. Since the idea of the Junior Academy originated with A.A.A.S., it seems that the office of the Permanent Secretary is the logical place for such registration. A small fee might be charged either to the individual clubs or to the Junior Academies to defray the expense of postage, provide membership certificates, and to issue some publication four times a year on the level of the club sponsors, or club members. Much delay and inconvenience were encountered in this study because of the lack of authentic information. National registration would contribute to a dignified, official affiliation.

Third, that provision be made for the Junior Academies to hold annual meetings concurrently with the mid-winter meetings of A.A.A.S., at which time the best exhibits and discussions of the Junior Academies would be presented.

Fourth, that the members of the State Academies of Science cultivate a spirit of tolerance for the work of the Juniors by not applying the standards for graduate research to that of the Junior members. Appreciation of the club work will be greatly increased by occasional visits from the senior members which will prove helpful and illuminating.

Fifth, that the work of the Junior Academy needs to be judiciously expanded since there are but thirteen state academies and three city academies. The American Science Teachers Association seems to be the logical agent to promote this work. ●

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(7) Kentucky club member.
(8) Letter from out of state club sponsor.
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(10) Letter from Kentucky club sponsor.
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Fluorescence

Continued from Page Sixty-six

will appear blank in ordinary light, but in black light the letters will be visible.

Esculin may be used as an invisible writing fluid. White paper or cloth treated with this liquid will be blank in ordinary light.

The sewing classes in the home economics department may also learn something about science from this project. The girls will find it very interesting to make costumes for the school operetta or assembly programs. Since the material is fluorescent only after treatment with the liquids described, the cloth will first have to be made chemically active by the science club sponsoring the program. The girls will find it great sport to test their finished products in the black light, and the teacher working with these students may at the same time teach an interesting lesson in science. They may also embroider designs with fluorescent thread or yarn. Some very unique patterns can be worked out in this way. Lace centerpieces may be purchased and parts of the design painted with fluorescent paints.

Use of the Fluorescent Paints

Fluorescent painting likewise provides an entirely new activity for students in the art classes. All sorts of posters may be worked out. The actual work of the artist must be done in a darkroom under the rays of the black light. Since some of the paints are colorless, others brown or gray, the designs will have a drab appearance in ordinary light. A clever art student will find it very interesting to develop scenes of this type. It is needless to state that he will be asking questions about the light and the paint, thereby learning a valuable lesson in science.

In describing uses of the light-sensitive paints, perhaps undue emphasis has been placed upon activities in which girls are interested. Fluorescence also has a place for the boy who excels as an amateur detective. Dry powdered anthracene, which produces a green fluorescence, is often used to detect finger prints. Similarly, forgeries are frequently detected with the invisible rays since any erasure represents a change in the texture of the paper that is easily discernible.

If the teacher wishes to make this project more technical, he may show how black light will aid the chemical analyst. Various products containing adulterants may be analyzed in this way. Impurities in coffee, tea and cocoa can readily be detected by the cold light. One may tell the difference between butter and margarine, lard and grease, sugars of different origin, flours, vinegar and acetic acid, textile fibers of different kinds and a host of other products. Public libraries contain many books that will be of service in this field.

The writer believes that projects of this nature go a long way toward securing a better scientific attitude. Student interest, once aroused, can be taken over more rugged roads with better results. ●

(above) The 4" and 8" Aluminum Desiccators have broad rims and covers ground to fit.

(left) The Fisher Desicooler eliminates breakage. It can be placed in an oven for reactivation of the desiccant.

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Teacher Preparation

Continued from Page Seventy-seven

vels of God's creation. This interest can be furthered by student activities directed by the teacher,—activities such as field trips to museums, to botanical gardens, to pasteurizing plants, to industrial centers, etc. Science clubs and classroom projects are likewise great incentives to pupil interest.

We would never go to a store to buy several small objects and expect to have them handed to us without a wrapping. So too, since we have spoken of the essential subjects required of a science teacher, we must not leave her struggling with this information; we must tie it up so that she can get it across to her students. Therefore, we will wrap it up in both a scientific and a modern fashion,—in the cellophane known as "methods" courses. In general, methods courses can do little more than to suggest situations which will arise in the classroom when, unfortunately, we allow the interest of our energized "homo sapiens" to waver. However, a good methods course will help the beginner to plan assignments, to budget time which is always at a premium, to select textbooks, to keep records, to handle laboratory materials and apparatus, and to improvise simple demonstrations when the necessity arises.

When the training of the teacher has been such as to enable her to relate the desiccated theories of textbooks to the problems of everyday life, then her courses will be functional, and successful results will be obtained. One may well question the meaning of the term "successful results." The primary aim of science teaching is not to develop students who will get high averages when examined on textbook material but, unfortunately, circumstances sometimes require us to do this very thing. The primary aim is to develop the interest of the pupil in his surroundings, to inculcate desirable habits such as intellectual honesty and love of truth, to exercise the ability to reason from phenomena to principle, to form habits for the profitable use of free time, and to encourage the pupil to face the facts of life squarely by an understanding of causes and effects.

It is evident that the science teacher should not only be thoroughly prepared in her special field, but that she should also have a general knowledge of related subjects because her type of work brings her into such close contact with the everyday life of her students. This close contact is bound to have a decided influence of a good, bad, or indifferent nature, according to the teacher's preparation and personality. Therefore, as Catholic and religious teachers of science, we must, as educators put it, be prepared to encourage simultaneous thinking, the kind which deals with whole situations instead of isolated ones; we must be able to shift from a science of chloroformed, fixed, dissected specimens to a science of living things, in which no problem is fully explored until we have considered it in all its ultimate scientific, industrial, and social relationships with regard to the secondary school student. ●

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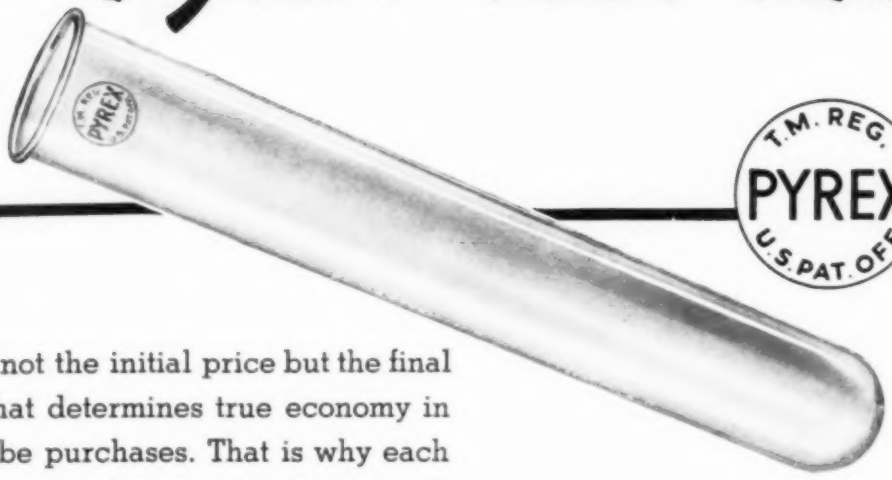

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Lead

Continued from Page Seventy-nine

erally conducted in blast furnaces but, before the concentrates can be charged into the furnace, they must be roasted to remove most of the sulphur contained in the concentrates and to agglomerate the very fine flotation product which is not a physically desirable blast furnace material. The roasted concentrate, or sinter, now in the form of lumps, is charged into the top of the heated blast furnace with suitable fluxes and coke. A blast of air is admitted to the lower part of the furnace to aid combustion and to complete the formation of metallic oxides which are reduced to metal by the coke and carbon monoxide present. The non-metallic waste forms a slag with the fluxing materials.

The blast furnace is then tapped so that the lead flows off into kettles or molds. In this form, the lead is a semi-finished product known as base bullion, containing silver and impurities. Incidentally, this is the form in which most of the lead imported for treatment arrives into the United States. Specifically, base bullion contains small amounts of gold, silver, copper, zinc, antimony, arsenic, bismuth and other impurities which must be removed in whole or in part by refining to produce a commercial lead.

The most widely used refining process is the Parke's process. By this treatment the lead is first melted and allowed to cool below the freezing point of copper, which crystallizes and is removed by skimming. It then passes to a reverberatory or softening furnace where the temperature is raised and the molten lead stirred. A blast of air oxidizes any antimony or arsenic present, both of which impurities harden lead (hence the term "softening" furnace), and these oxides are skimmed off. The lead then goes to the desilverizing kettles where small quantities of zinc are added. Gold and silver are more soluble in zinc than in lead, and, consequently, any of these metals present in the lead immediately leave it in favor of the zinc. As zinc is lighter than lead, the zinc rises to the surface and, when the temperature is lowered, solidifies, and is skimmed. This leaves only a little zinc remaining as an impurity which is oxidized and skimmed in a reverberatory furnace. Refined lead becomes one of the purest of the commercial metals through this treatment, and is cast into pigs.

To the reader interested in studying the subject of lead mining or lead metallurgy thoroughly, numerous textbooks are available, together with the transactions of the American Institute of Mining and Metallurgical Engineers, in which are recorded, from year to year, progress in the art. ●

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NEW BOOKS

Round the World in Industry

By GERALD COLLINS. Hearthside Press, Chemical Publishing Co., Inc., New York. 1940. xi + 180. Illustrated. $2.00.

Announced as written "for those from nine to ninety" this book should prove attractive to readers of all ages, but it will be especially interesting to those of high school age and under who want to learn about a number of vocations that are out of the ordinary. Mr. Collins discusses seal hunting, cattle raising, deep sea diving, gold prospecting, coal mining and cable laying. He tells the stories of the press photographer, the ship's captain, the airplane test pilot, the tunnel worker, the oil driller, the film stunt man, and tales of other workers who lead colorful and romantic lives.

This material is not presented in the usual manner of books on the study of vocations. Real men work at real jobs. Reading this book will be fun for the boy, not study, not work. You can enjoy it yourself. J.F.M.

Science for Handicraft Students

By H. MORTON, B.Sc., A. Inst.P., Mining and Technical College, Wigan. Chemical Publishing Co., Inc., New York, N. Y. 1940. 149pp. Illustrated. $3.00.

This English publication is intended as an elementary textbook for workers in wood and metal. By means of experiments it studies the underlying principles of mechanics, hydrostatics, chemistry and electricity and their relation to shop practice and to everyday living.

A considerable number of topics are included, some of them not very elementary. Line drawings are used as illustrations. Descriptions are brief and terse. Explanations are adequate. There is no attempt to sugar coat. H.C.M.

Bill and the Bird Bander

By EDNA H. EVANS. John C. Winston Co., Philadelphia. 1940. 220pp. Illustrated. $1.50.

An especially well made, interesting, and beautifully illustrated juvenile for boys and girls in grades four to nine. The method of using "bracelets" of aluminum as a means of keeping track of the lives, habits, and travels of birds is taught to a young boy who is permitted to accompany a trained scientist while he makes ornithological studies along the Florida coast. The personal experiences of the author and her husband form the basis of the book. Authentic information, adventure, excitement, and amusement all are to be found in this group of entertaining stories.

This book will help the teacher "put across" the unit on birds. H.C.M.

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